THE HEATING AND VENTILATING MAGAZINE

Cooperstown, N. Y. JUNE, 1917 1123 Broadway, New York

Experimental Plant of the New York State Commission on Ventilation in School No. 51 New York City

The New York State Commission on Ventilation, which has been pursuing its investigations since 1913 has but recently completed the trying out of a second set of experiments. These were based more on actual operating conditions, than those of the laboratory, as was the case in the first set of experiments made at the Biological Laboratories of the College of the City of New York. In order to secure an environment of the most practical, every-day nature these tests were made under ordinary operating conditions such as are attained in the common public school building. For this purpose the use of two rooms in Public School No. 51, situated in the Bronx, New York City, was secured from the New York Board of Education through the efforts of its chief heating and ventilating engineer, Frank G. McCann. These rooms are on the second floor and consist of rooms Nos. 203, and 205, each having 48 sittings and a teacher's desk, making a total of 49 occupants each when fully occupied.

Fig. 1 shows the general arrangement of the two rooms and their close similarity; the black dots in Room No. 205 indicate the location of floor outlets, more clearly shown in Fig. 3.

DETERMINING EFFECTS OF RECIRCULATION.

One of the principal objects of these experiments was to determine more closely the saving and physical and mental effects of recirculation of vitiated air and to facilitate this, two rooms were selected as closely identical in size, window area, seating and other arrangement as was possible. Each room was supplied by a special ventilating apparatus which was entirely separate and distinct from that supplying the other room, and

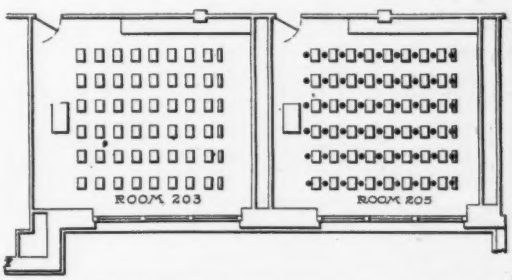


FIG. 1—ARRANGEMENT OF TWO ROOMS USED BY THE NEW YORK STATE VENTILATION COMMISSION FOR EXPERIMENTAL PURPOSES.

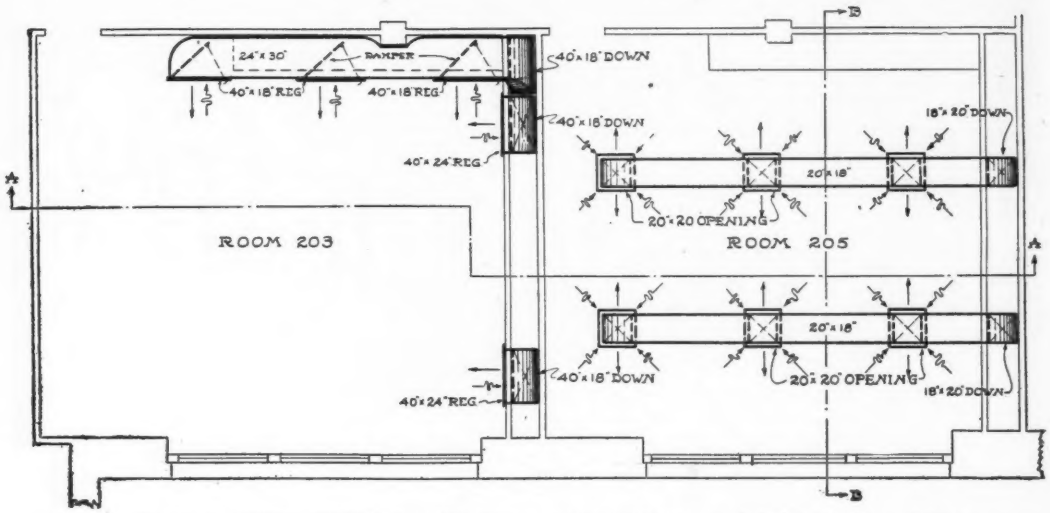


FIG. 2—PLAN OF UPPER REGISTERS AND DUCTS NEAR CEILING OF EXPERIMENTAL ROOMS.

to still further vary the combinations the air inlets and outlets were arranged differently in the two rooms.

The ventilating equipment was designed by the R. D. Kimball Company and installed by Child & Scott, heating contractors, under the supervision of H. L. Alt, superintendent for the Kimball Company. The registers were located at various points indicated in the ilustrations. In Room No. 203 three registers 18 in. × 40 in. were located along the corridor wall with the bottoms 8 ft. above the floor. These were connected to one duct. Beneath these registers and at the floor were set three other double registers of lattice pattern, two of these coming in the face of the wardrobe and one in a false extension of the wardrobe at the left end. These were also connected to the same duct, but were supplied with dampers so that either the upper set of registers or the lower set of openings might be used as desired.

Across the back of the room were set two more registers 8 ft. above the floor, with two other registers directly below them at the floor level; these are illustrated in Fig. 6. The registers near the windows were connected into a single duct with dampers so that either top or bottom register could be used and those

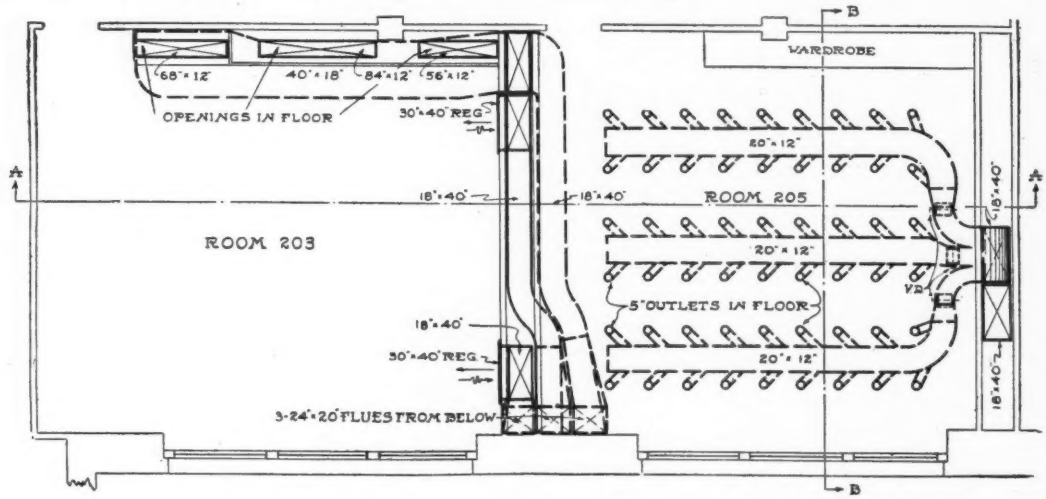


FIG. 3—LOWER REGISTERS AND DUCTS AT OR BELOW FLOOR OF EXPERIMENTAL ROOMS.

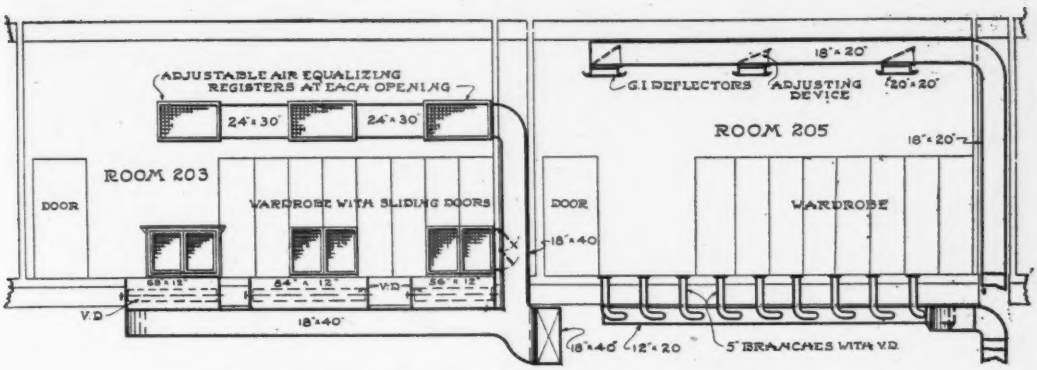


FIG. 4—ELEVATION ON LINE A-A OF FIGS. 2 AND 3.

toward the corridor were similarly treated. This made three separate ducts for Room No. 203 of which any or all could be made top or bottom registers and supply or exhaust as desired.

CEILING OUTLETS IN ONE ROOM.

In Room No. 205 a different scheme was followed out, no inlets being provided in this room in the wall; on the contrary six ceiling outlets 20 in. × 20 in. were provided, these being arranged on the ceiling so as to be in the centre of each of six equal rectangulars into which the room was divided, the rectangulars being based on the location of seats. These outlets are connected in threes to an 18 in. × 20 in. flue, the two flues being united into a 40 in. × 18 in. flue, as shown in Fig. 5, and carried back to the apparatus in the basement. In the floor at each seat is provided a circular opening into which mushrooms or goosenecks could be inserted so as to give each pupil an individual fresh air supply or exhaust as desired. These were covered by square beveled flush wooden covers which may be placed over the outlets if it is desired to eliminate all floor ventilation. These openings are connected into three 12 in. × 20 in. ducts run on the ceiling of the playroom which comes directly below the two experimental rooms as shown in Figs. 4 and 5, this duct being carried back to the apparatus and making two flues from Room No. 205.

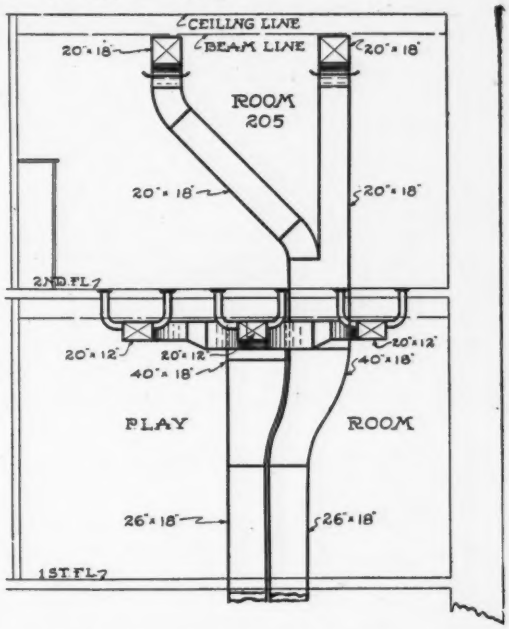


FIG. 5—ELEVATION ON LINE B-B OF FIGS. 2 AND 3.

In the basement each room is connected to its own ventilation equipment, as illustrated in the plan and elevation, Fig. 10; apparatus for each consists of a fresh air suction chamber SC; a tempering heater, TH, consisting of two rows of five sections each of 40-in. narnow Vento heaters, 4⅝ in center-to-center; a Type A Carrier air washer, AW, 7 ft. long, 2 ft. 9 in. wide and 4 ft. high, capable of handling 2,500 cu. ft. per minute; a heater, H, consisting of one row of 5 sections of Vento heater similar to that already described; a No. 4 Sturtevant Multi-vane supply fan, SF, and operated by direct-connected 1½

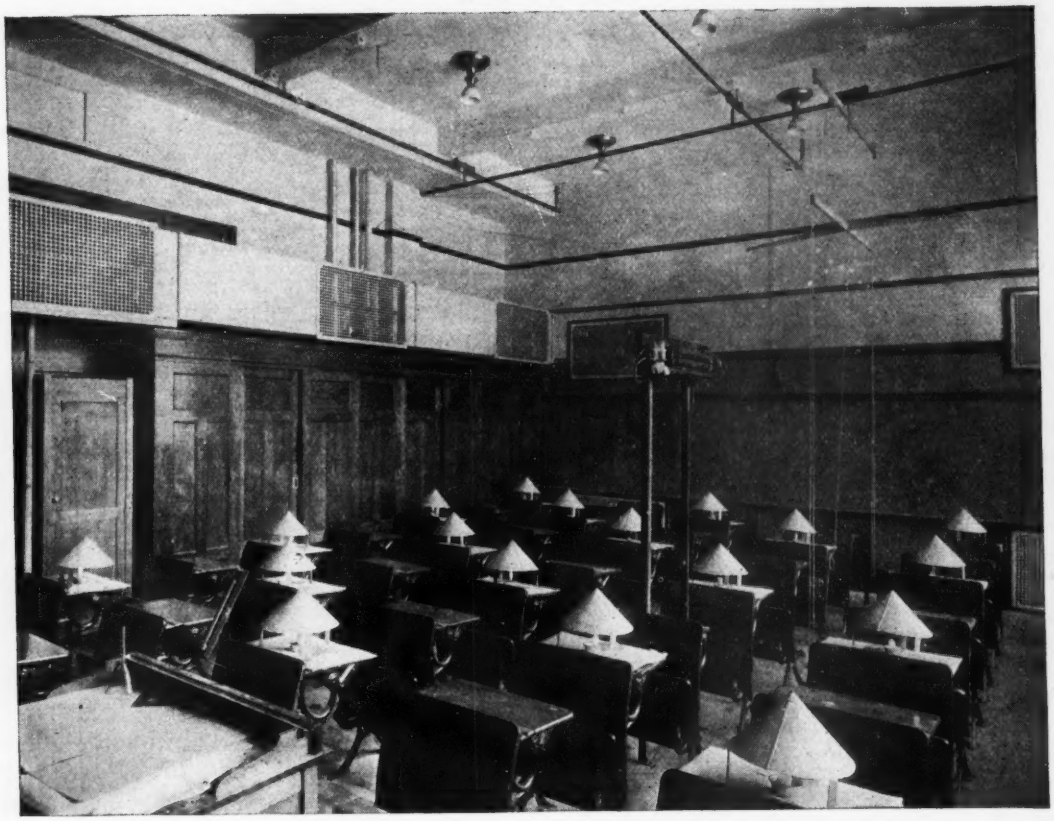


FIG. 6—VIEW OF ROOM NO. 203 LOOKING TOWARDS BACK OF ROOM.

H. P. direct current Sprague motor, and a re-heater, RH, consisting of two rows of Vento, being a duplicate of the tempering heater, already described.

The exhaust fan, EF, is a No. 4 Sturtevant Multi-vane fan similar to the supply fans described and is direct connected to 1 H. P., 230-volt direct-current Sprague motor with a No. 2150 Cutler-Hammer controller. All sheet metal work is No. 24 gauge galvanized sheet iron with suitable stiffeners.

Each coil has a 1½ in. steam supply and 1 in. return connection, the returns being taken through a thermostatic trap and thrown away into the sewer. The supply connections to the heaters have gate and diaphragm valves with Johnson thermostats and automatic control while the return connections have strainers and Webster thermostatic valves. Steam is supplied to the system through

FIG. 7—VIEW IN ROOM NO. 205, LOOKING TOWARD FRONT, SHOWING CEILING DUCT AND OUTLETS AND FLOOR OPENINGS.

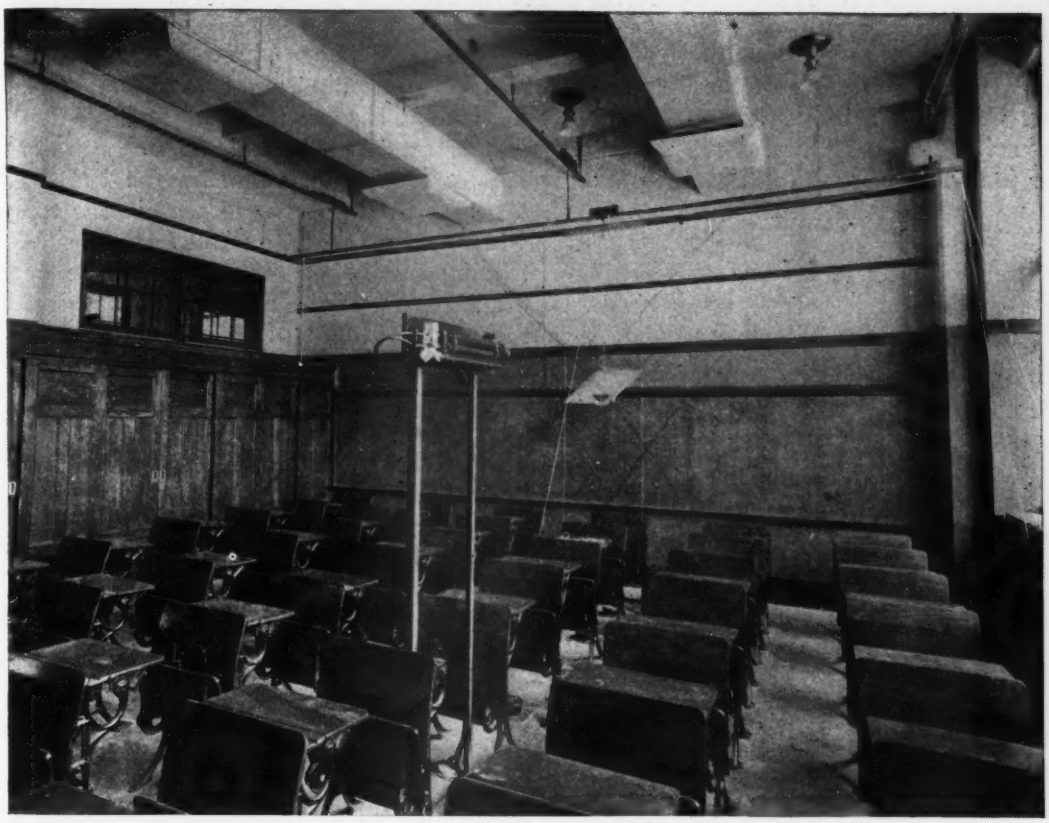


FIG. 8—VIEW OF ROOM NO. 205, LOOKING TOWARD THE REAR.

FIG. 9—METHOD OF CARRYING THE DUCTS ACROSS THE CEILING OF THE PLAYROOM BELOW THE EXPERIMENTAL ROOMS AND OF DROPPING THE FLUES DOWN TO THE BASEMENT APPARATUS ROOM.

a 3 in. Standard Regulator reducing valve, which is a valve of the diaphragm type placed on a branch from the steam main furnishing high pressure steam to the fan engines that operate the school fans which ventilate the balance of the building.

The temperature control system consists of one duct thermostat situated in the cold air intake which is set at 35° and controls the 1½-in. diaphragm valve on the first row of the tempering heater. A second duct thermostat is situated between the washer, AW, and heater, H, this being set at 40° and controlling the 1½- in. diaphragm valve on the second row of the tempering heater. A third thermostat is placed in the fresh air fan intake set at 60° and controlling the 1½-in. diaphragm valve on the heater; a fourth thermostat is located in the top plenum chamber, HA, set at 70° and controlling the 1½-in. diaphragm valve on the first row of the re-heater and a fifth thermostat in the top plenum chamber, HA, set at 80° and controlling the 1½-in. diaphragm valve on the second row of the re-heater. There is also installed one room thermostat in the class room controlling the mixing dampers in the

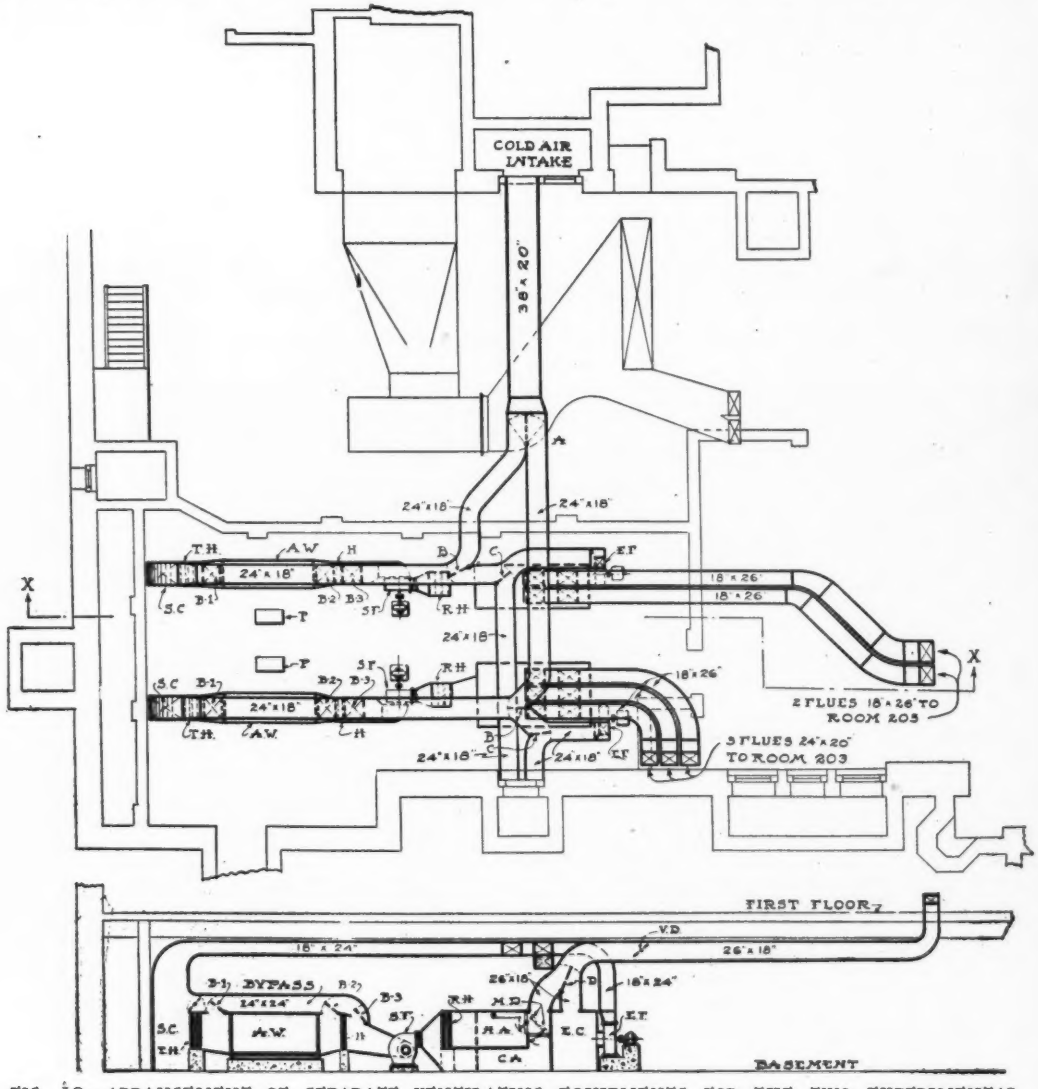


FIG. 10—ARRANGEMENT OF SEPARATE VENTILATING EQUIPMENTS FOR THE TWO EXPERIMENTAL ROOMS.

plenum chamber and a humidostat in the exhaust chamber, EC, controls the 2-in. diaphragm mixing valve on the hot water heater through which the air washer water is circulated.

When fresh outside air is used alone it enters through the main duct from the cold air intake and is deflected by by damper "A" to either apparatus as desired; it then passes across the top of the apparatus on the ceiling and drops down into the suction chamber, SC, in front of the tempering heater, TH. From this point to the supply fan it may pass either through the tempering heater, air washer and heater or it may be shunted across above these through a 24 in. × 24 in. bypass so as to bypass either the tempering heater, the air washer, the heater or all three by the use of bypass openings B1, B2, or B3. After entering the fan it is discharged through the heater into the hot air chamber, HA or through the bypass below the heater into the cold chamber, CA, according to the amounts of air allowed to pass out of

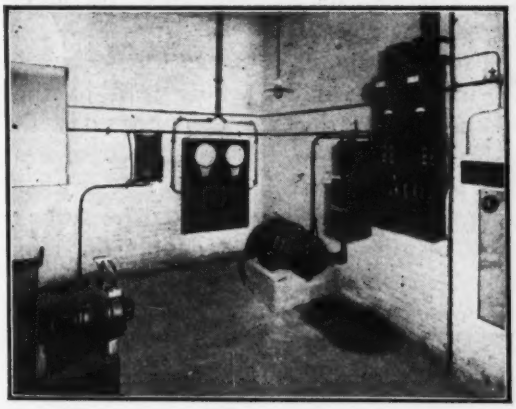


FIG. 11—TEMPERATURE CONTROL AND OTHER EQUIPMENT FOR EXPERIMENTAL APPARATUS.

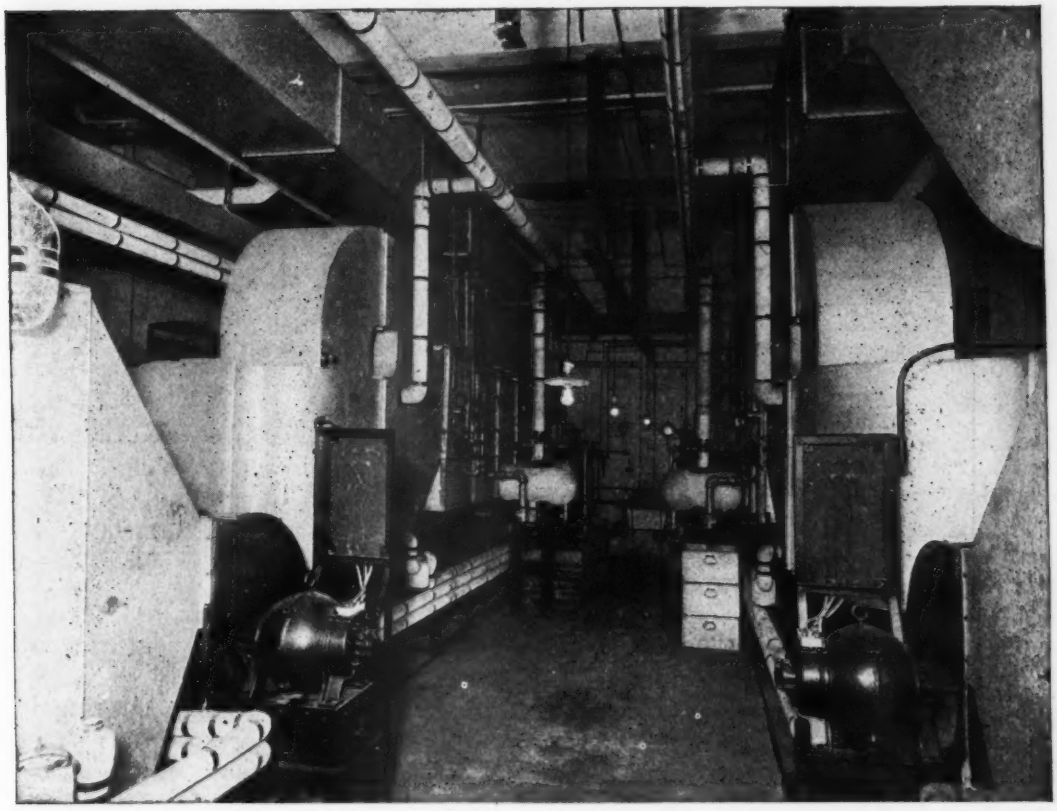


FIG. 12—VIEW OF APPARATUS ROOM, SHOWING AIR WASHER, PUMP, HOT WATER HEATER FOR AIR HUMIDIFYING AND SUPPLY FAN.

each chamber by the position of the mixing dampers, MD.

From this point it enters the 26 in. × 18 in. supply ducts which lead to the room. These ducts are connected with a branch both to the mixing dampers and to the exhaust chamber, ES, so that air may either be supplied by the supply fan (making the duct a supply line) or may be exhausted into the exhaust chamber (making the line an exhaust line) by simply shifting damper D. The exhaust fan, EF, sucks the air out of the exhaust chamber, EC, and discharges it either to the outside air through the exhaust outlet or into the cold air intake which carries it back to the inlet side of the apparatus for re-circulation, this being determined by the position of dampers B and C.

The automatic control is operated by compressed air supplied Johnson air compressor, and current for the operation of the entire apparatus is furnished by a General Electric motor generator which transforms the two phase, alternating current into 220-volt direct current; the thermometer temperatures are recorded on Bristol recording thermometers, and the electric consumption is registered on electric meters made by the Sangamo Electric Co., Springfield, Ill., the arrangement of the equipment being shown in Fig. 11. Views of the apparatus room are shown in Figs. 12 and 13, Fig. 12 bringing out the air washer, air washer pump, P, hot water heater for air humidifying and supply fan; Fig. 13 is a view farther front showing the exhaust fans, plenum chambers, ducts and pressure reducing valve.

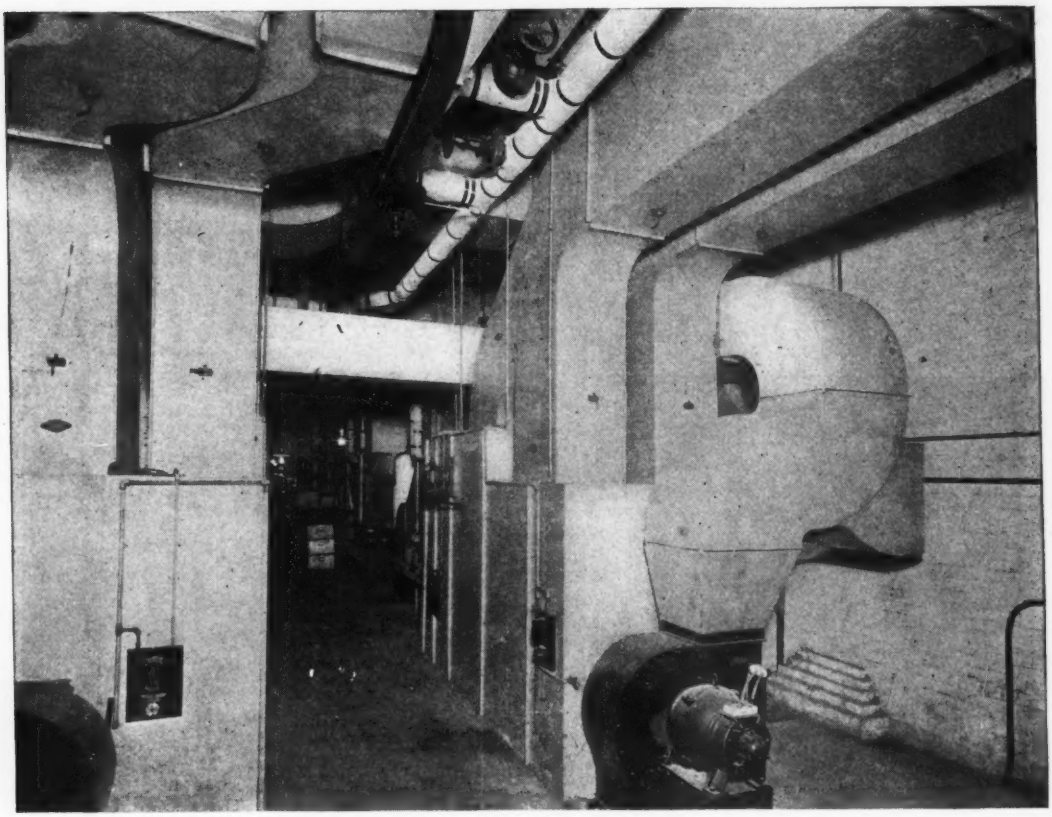


FIG. 13—VIEW FARTHER FRONT IN APPARATUS ROOM SHOWING EXHAUST FANS, PLENUM CHAMBER, DUCT WORK AND PRESSURE REDUCING VALVE.

The reports based on the tests made with this apparatus are now being compiled by the commission.

Quantitative Determination of Air Dust

A Review of the Difficulties Encountered and the Development of a New Type of Dust Counter

By E. VERNON HILL, M.D.

Chief of the Division of Ventilation, Department of Health, Chicago, Ill.

Exact information as to the amount and character of the dust in a given quantity of air is often extremely important. It can also be truthfully stated that to obtain this information is often extremely difficult, even impossible. A little thought regarding the character of of air dust shows why this is so.

Dust is solid matter in a state of fine sub-division, the size of the particles depending upon the character of the dust, its source, etc. The individual particles range in magnitude from those plainly discernible to the naked eye and large enough to be easily and accurately weighed and measured, down to particles so small that the highest magnification fails to reveal their presence, and we might say still smaller, almost to the ultimate molecule.

It is not difficult to devise methods for collecting and weighing or counting the large particles, but when we consider that dust particles as a whole occur in uniform gradations, from the largest to those almost infinitely small, we see at once that it is practically impossible to devise or design any instrument that will retain and account for all of them. Any statement, therefore, regarding the weight of dust in a given quantity of air or the number of particles determined by counting by any of the various methods, must be considered as a *relative* determination, the degree of relativity depending upon the method used. This, however, need not necessarily disconcert us, absolue determinations not being essential to exact work. It is only necessary to establish a standard method which is relatively correct and approaches exactness in so far as this is practically possible.

METHODS TRIED BY CHICAGO DIVISION OF VENTILATION.

The experiments conducted, the many failures recorded, and the final accomplishment of our aims with regard to dust determinations in the Ventilation Division of the Chicago Health Department may be of interest to those who are following similar lines of experimentation.

The methods we have tried may be divided, for the sake of convenience, into five classes, viz.:

1. Visual comparison.
2. Weighing methods.
3. Condensation methods.
4. Diffraction methods.
5. Counting methods.

1. VISUAL COMPARISON:

Under this classification the first experiments were conducted with:

(*a*) *Cheese-Cloth Screens:* This was the only method known at the time we instituted work of this character for testing the efficiency of air washers. We used cheese-cloth screens stretched on a square frame having an area of 1 sq. ft. The screens were exposed for a given length of time at the proximal and distal ends of the washer and the degree of blackening or discoloration roughly approximated as a percentage ratio. This method was only applicable to determinations in air washers or in ducts where a relatively high velocity was present and was at best only a crude approximation of the quantity of dust present.

(*b*) *Porcelain Dish:* Fig. 1 shows two porcelain evaporating dishes with which some rough experiments were conducted. No. 1 is a clean dish free from dust.

No. 2 is its counterpart which was coated with clean, white vaseline and exposed in the open air for a certain length of time. The comparisons are much the same as with the cheese cloth screen method.

2. WEIGHING METHODS:

(*a*) *Filter Bags:* Fig. 2 shows the

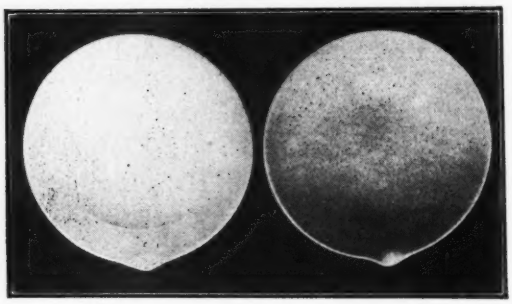


FIG. 1—PORCELAIN EVAPORATION DISHES FOR MAKING VISUAL DUST COMPARISONS.

next device used. It consisted of a small Sirocco fan to the inlet of which was connected a metal funnel fitted with rings for holding fine mesh muslin bags, which were suspended in the funnel. The outlet of the fan was also provided with a metal cone of gradual slope in which an anemometer was placed to determine the amount of air passing through the instrument. A small tin receptacle is shown in the illustration for carrying the filter bags and protecting them from dust while not in use.

The method was to dry and weigh each bag carefully, then place it in the cone inlet and pass from 100 to 500 cu. ft. of air through the same, then to again dry and carefully weigh, the increase in weight denoting the amount of dust in the quantity of air handled.

Quite a number of experiments were made with this device. One that is interesting should be mentioned. The instrument was placed in the intake of one of the ventilating units in the Chicago City Hall and a determination made of the quantity of dust entering. The instrument was then placed at the distal end of the air washer. As there was no space at the air washer outlet it was necessary to locate the instrument on the other side of the reheating coils; that is, the air passed through the air washer, then through the coils before reaching the instrument. We were surprised to find after completing this test that instead of a decrease the weight of the dust, after passing through the air washer and coils, had increased about 20%. The test was repeated with like results.

After some study of the results the writer concluded that the increased weight of the dust after passing through the coils must be due to particles of iron liberated from the coils and carried into the filter. The chemical test of the dust in the filter verified this conclusion. The fact that in cases of this kind our results were so misleading, the general cumbersomeness of the apparatus, the long time required in making a test, and the practical impossibility of making two tests at the same time, and also the fact that much of the finer dust passed through the filter, led us to discard this instrument as being impracticable and unreliable.

(*b*) *Cotton Filters:* Fig. 3 shows the next device employed. This consisted of a gas testing meter, the outlet of which was connected to a high-speed centrifugal fan mounted on a suitable resistance box with the necessary fuses,

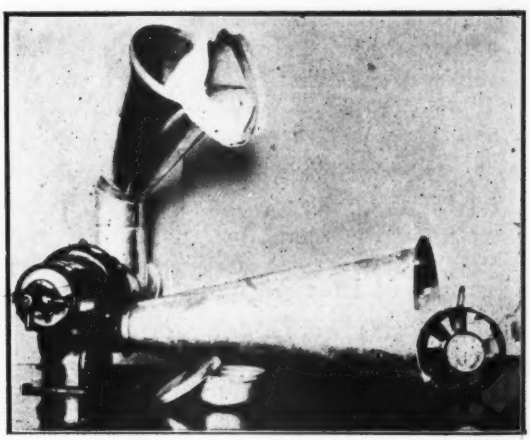


FIG. 2—FILTER BAG DEVICE.

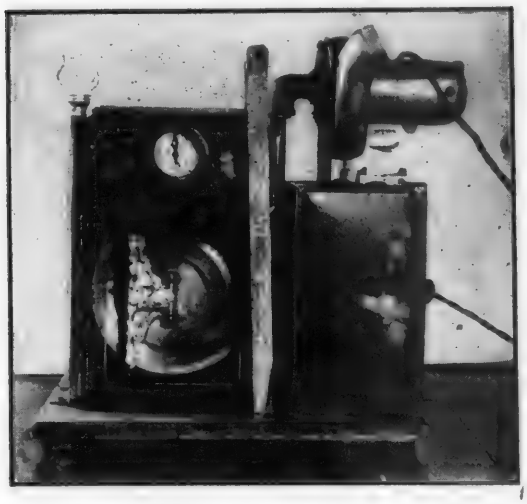


FIG. 3—COTTON FILTER METHOD.

switches, etc. The inlet of the meter was equipped with a glass receptacle, shown diagrametrically in Fig. 4 and so constructed that it could be used with either cotton, sand or sugar as filtering material. In this method the cotton was carefully dried and weighed, as with the filter bag method.

The superiority of this method over the one just described was that the gas meter made it possible to more accurately measure the quantity of air handled. The objections were the same as those noted in the filter bag method; also difficulty in weighing accurately the minute quantities of dust collected in comparatively clean air, even though 1,000 cu. ft. or more was passed through the instrument,

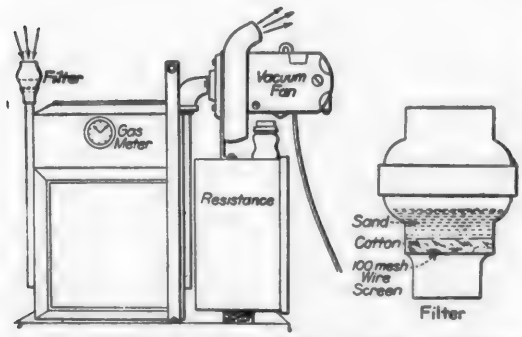


FIG. 4—DIAGRAM OF COTTON FILTER METHOD SHOWING GLASS RECEPTACLE AT INLET TO GAS METER.

and the fact that the weight changed, due to absorption, during the process of weighing. These elements of error made it apparent that this method was impractical and could not be relied upon.

(*c*) *Drechsel Wash Bottles:* This is a common method of collecting dust, gases, etc. by bubbling them through water. Considerable experimental work in testing air washers was carried out by this method. Figs. 5 and 6 show the method of using the wash bottles. A battery of six were installed both at the proximal and distal ends of the washer, the outlet from each set of bottles being connected to a common air pipe and these to the inlets of the gas meters. The outlets of the meters were connected to an exhaust tank provided with a vacuum

FIG. 5—DRECHSEL WASH BOTTLES.

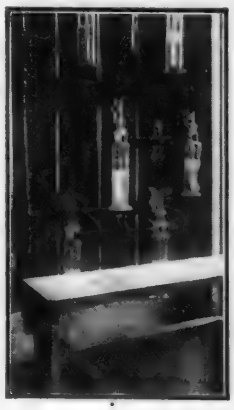


FIG. 6—DRECHSEL WASH BOTTLES.

gauge and automatic relief valve, to prevent excessive pressure.

In collecting dust by this method it was necessary to run a test for several days in order to get a sufficient amount of dust in the bottles at the distal end of the washer to make an accurate determination. After passing say 50 to 100 cu. ft. through the apparatus the bottles from each end were emptied into separate evaporating dishes, the water evaporated and the residue weighed. This method is fairly accurate with one exception, to be noted, but it is applicable only to work of this kind and requires a large amount of apparatus and consider-

able time. The inaccuracy is due to the fact that all dust is *not* retained in the bottle when bubbled through even at a slow velocity, as the finer particles in the interior of the air bubbles are carried through. This subject will be referred to later.

FIG. 7—KONISCOPE, DEVISED BY PROFESSOR JOHN AITKEN.

3. CONDENSATION METHODS:

(*a*) *Koniscope:* This instrument, shown in Fig. 7 is the early instrument devised by Professor John Aitken. The long horizontal tube is lined with hygroscopic material. It is provided with a window at each end and a stop cock at the distal end for admitting the air. The vertical portion of the instrument is a suction pump connected directly with the interior of the horizontal tube. Air for testing is drawn into the apparatus through the stop cock by depressing the plunger of the pump. The stop cock is then closed and the pump piston again depressed. This action rarifies the air in the tube which has become saturated by contact with the wet lining. Lowering the pressure in this manner has the same effect as lowering the temperature, the result being that the dew point is lowered and a fog produced by aqueous condensation on each dust particle, the density of which by comparison with suitable charts determining the extent of air dustiness.

Owing to the personal element involved in the use of this apparatus its value is questionable except when always used by the same person, and even then the results are not always consistent.

(*b*) *Aitken Dust Counter:* This is the next instrument designed by Professor Aitken in an endeavor to correct the defects in the Koniscope. It is shown in Figs. 9 and 10. In this instrument the same principle is made use of, but the condensed moisture is precipitated on an observing plate rather than viewed as a fog, as in the Koniscope previously described, and instead of observing the density or color of this fog the precipitated dust particles are actually counted.

The machine consists of a precipitation chamber with pump, eye piece, filter, etc., mounted on a tripod in a convenient and

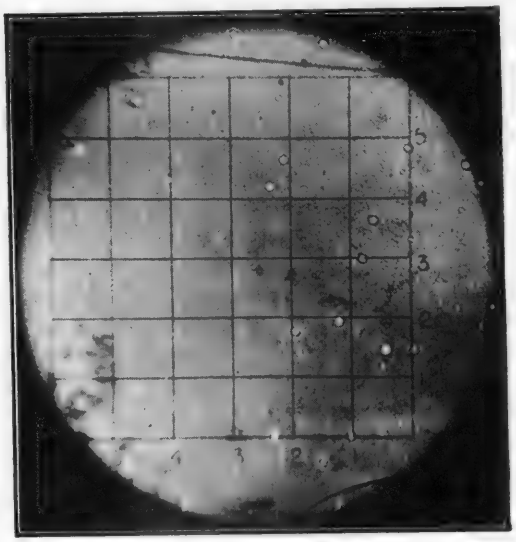


FIG. 8—MICROPHOTOGRAPH OF DUST TAKEN IN AITKEN DUST COUNTER.

portable manner. For a complete description of this instrument the reader is referred to the 1914 report of The Chicago Commission on Ventilation.

This instrument was used by the Chicago Health Department for a considerable period and for some time reliance was placed on the results obtained. Frequently we found, however, that the results were not consistent and where we

might reasonably expect to obtain a very low dust count we obtained the opposite, a very high one, although in these instances the particles of precipitated moisture were extremely small. It developed, on further study, that the instrument was accurate, in fact it was extremely so and the precipitation of large numbers of minute droplets proved to be dust particles so fine that they could not be discerned with the high power of the microscope and were, consequently, outside the range of those particles which we wished to detect and count. For this reason the instrument is impractical for the work intended.

4. DIFFRACTION METHODS:

(*a*) *Diffractoscope:* During the course of these experiments the writer conceived the idea of using a modification of

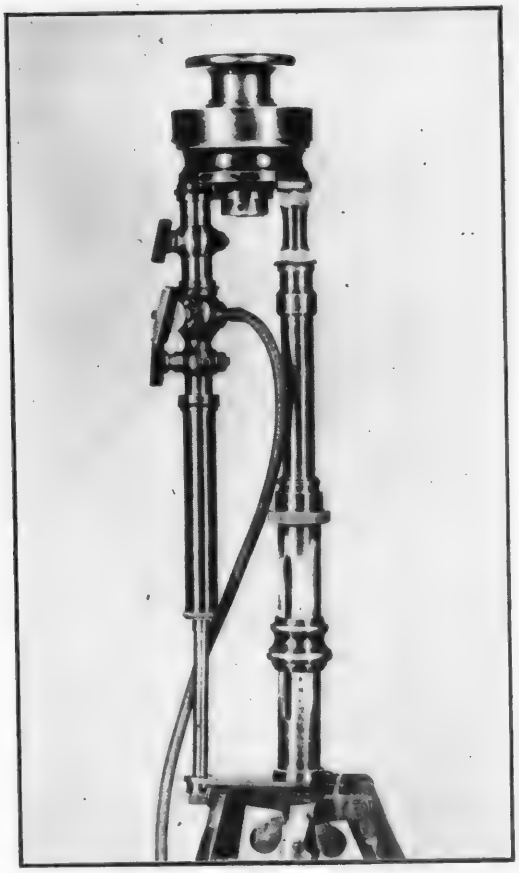


FIG. 9—AITKEN DUST COUNTER.

FIG. 10—AITKEN DUST COUNTER IN USE.

the Aitken machine in which the presence of dust might be detected by means of the diffraction of rays of light by the minute droplets of water in the fog produced by lowering the dew point. The instrument * is shown in Figs. 11 and 12. It consists of a metal chamber 2½ in. in diameter and 6 in. long, lined with hygroscopic material and provided with windows at either end and on one side. A filter with a three-way cock, which allows air to be drawn through the same or directly from the outside, is attached to one end of the instrument and a hose cock connection for exhausting the air at the other. The method of using the instrument is as follows:

The hygroscopic lining of the chamber is saturated with water, the three-way cock is then turned so that air is introduced through the filter by operating the pump at the exhaust outlet and the chamber thus filled with clean, filtered air. A beam of light is now thrown into the side window from a strong arc. If the air in the instrument is free from dust a reduction of the pressure will not produce a fog and consequently the light beam will not be visible. If dust is

* Furnished through the courtesy of William G. Braemer, then manager of the air conditioning department of Warren, Webster & Co.

present in the instrument a fog will result and the light beam stand out clearly. It developed, however, in experimenting with this device that air from the distal end of the washer, or air passed through a Drechsel wash bottle at a very low velocity still gave a positive result with the diffraction method. In other words, washing the air does not remove a sufficient amount of dust to prevent the formation of a fog when the pressure is reduced. If, however, the air is drawn into the instrument and allowed to stand for several hours, or a sufficient length of time for all of the dust to settle on the walls and bottom of the chamber, a reduction in pressure *does not* produce a fog, proving conclusively that dust must be present in order for a light beam to become visible. The instrument, therefore, is extremely accurate but too delicate for ordinary test work.

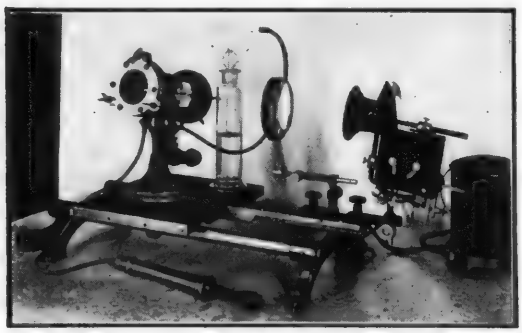


FIG. 11—DIFFRACTOSCOPE FOR DETECTING DUST BY DIFFRACTION OF LIGHT THROUGH MINUTE DROPLETS OF WATER PRODUCED BY LOWERING DEW POINT.

It has been of considerable value to us in the study of this subject and is evidently a reliable method of determining when a given sample of air is absolutely free from dust. Its use proves and illustrates the fact that air ordinarily considered dust free contains an enormous number of extremely fine particles that are not revealed by ordinary methods.

5. COUNTING METHODS:

(*a*) *Sugar Filter:* Fig. 4 showing the gas meter equipped for determining the amount of dust by collecting on a cotton filter and weighing, could also be adapted to dust counting by using sugar in the receptacle instead of cotton, filtering the air through this medium, dissolving the sugar in distilled water and making a count with the Sedgwick-Rafter counting cell. It is necessary to make control counts of the sugar when this method was used.

We found during these experiments that Crystal Domino sugar, put up in cartons, was practically free from dust. This method is fairly satisfactory, but certain elements of error exist which it is difficult to overcome. When the sugar is dissolved in the distilled water and a small portion taken for the count the receptacle containing the solution is first shaken to be sure that the particles contained do not settle to the bottom and to evenly distribute them throughout the liquid. This process breaks up some of

FIG. 12—LOOKING THROUGH THE DIFFRACTOSCOPE.

the large dust particles into numerous smaller ones and the resulting count is, therefore, considerably higher than it should be. The fact that a small portion only of the liquid is used is also an element of error that cannot be overcome.

The process of counting with the Sedgwick-Rafter cell is difficult, tedious and liable to error owing to the fact that the depth of the cell makes it necessary to re-focus and count at various depths through the specimen. With this method we not infrequently obtain results varying from 50% to 75% where we had reason to expect uniformity.

(*b*) *Drechsel Wash Bottles:* Instead of evaporating and weighing the residue in the wash bottle method we sometimes take specimens of the water in the bottle and make a count with the Sedgwick-Rafter cell. The count under these conditions was not as uniform or consistent as with the weighing method, due to the difficulties just enumerated.

(*c*) *Photographic Dust Count:* In the summer of 1916 the author noted, in developing micro-photographic plates, that the smallest particles of dust on the negative became fixed on the film during development and cracked off when drying, producing a clear spot on the glass. It occurred to me that this method might be used in developing a simple dust counting instrument and the one shown in Fig. 13 was the result. This consisted of a metal frame carrying an anemometer at the end where the air passed into the instrument, an exhaust ventilator at the other end to facilitate air motion through the same, and a compartment part way between, carrying a small 2¼×3¼ in. plate-holder so arranged that the entering air was thrown directly against the center of the plate. In using the instrument the plate holder is opened and clean distilled water applied to the central portion of the plate with a clean camel's hair brush. The water softens the film on the plate which retains the dust particles that are forced against it. After exposing it in a current of air where a dust determination is to be made, or swinging it if there was no air motion, the plate is dried and developed in the ordinary manner. The count of the particles is made with the aid of low magnification or prints made from the negative as in ordinary photographic work. This instrument is very simple and easy to use and if extreme accuracy is not desired gives very fair and consistent results.

The principal objection to the instrument is that dust particles will lodge on the anemometer and various parts of the interior of the instrument in front

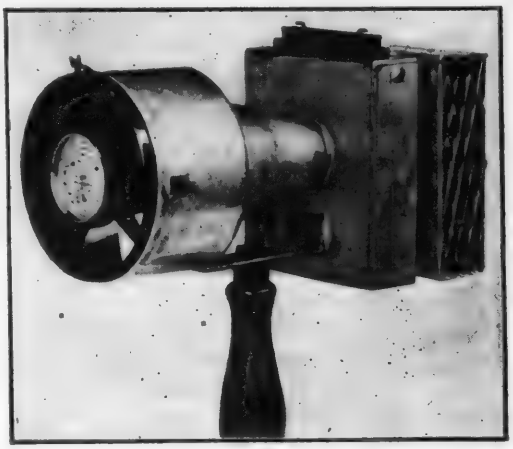


FIG. 13—PHOTOGRAPHIC DUST COUNTER.

of the photographic plate, and unless carefully cleaned before every test are a serious source of error. The thorough cleaning of the instrument is tedious and difficult and its utility is, therefore, diminished to that extent.

The next and the last device is the dust counter shown in Fig. 14. This consists essentially of an exhaust pump of known capacity for handling the air and a small capsule or shell affixed to the inlet of the pump carrying a cover glass, coated with adhesive material for catching and retaining the dust.

The first design of this instrument is shown in Fig. 14. The writer's first experiments in this line were made by drawing a quantity of air into a syringe and forcing it out against a slide covered

with adhesive material and counting the number of particles with a microscope. In using this method we found a serious source of error in the retention of dust particles in the barrel of the pump. A device was, therefore, arranged to carry the cover slip on the interior of the pump directly beneath the intake nozzle. With this arrangement the dust was projected against the adhesive material before coming in contact with the interior of the pump.

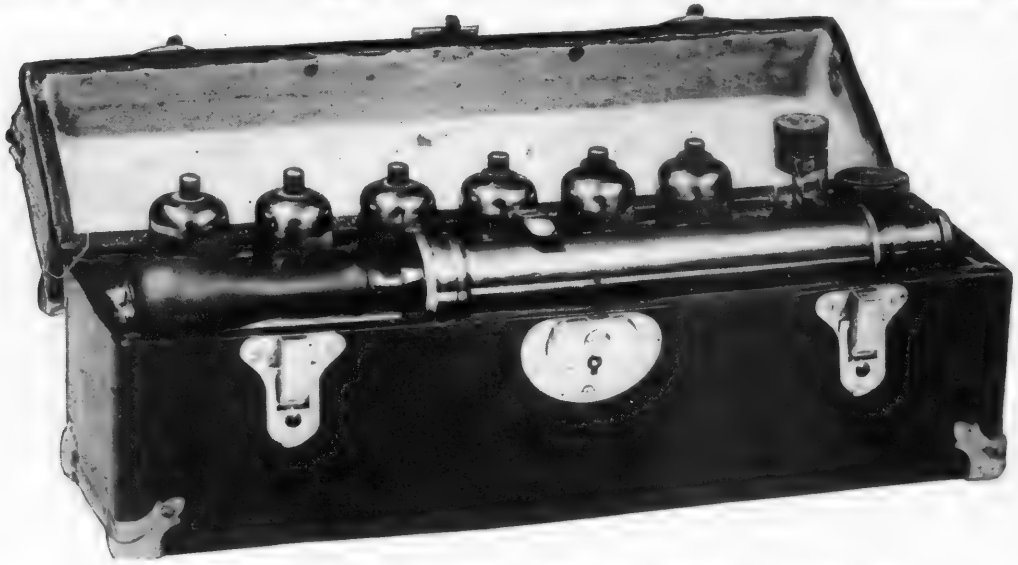


FIG. 14—NEW TYPE OF DUST COUNTER DESIGNED BY DOCTOR E. VERNON HILL.

This was the first instrument developed in the long series of tests with which a consistent and practical determination could be made. In developing the idea just described the next step was to find some means of calibrating the instrument. It was evident that all of the dust projected against the adhesive plate was not retained, some must of necessity escape. We, therefore, constructed a number of capsules as a separate part of the instrument and designed them in such a way that one could be superimposed upon the other and the air sample drawn through them in series (See Fig. 15). By experiment we found that with six such capsules under ordinary or moderately extreme conditions of air dustiness no dust was found in the last capsule. Counts were then made of the samples in the consecutive capsules and a percentage determination arrived at for the amount retained by the first capsule. In routine tests with the instrument, therefore, it is only necessary to use one capsule and correct the result by the factor given for the nature of the work in hand. This for ordinary tests is 62%.

Fig. 16 is a detailed drawing of the instrument and Fig. 17 is a photograph of a dust sample taken. This machine has been in use in the Chicago

FIG. 15—HILL DUST COUNTER WITH SUPERIMPOSED CAPSULES FOR CALIBRATING THE INSTRUMENT.

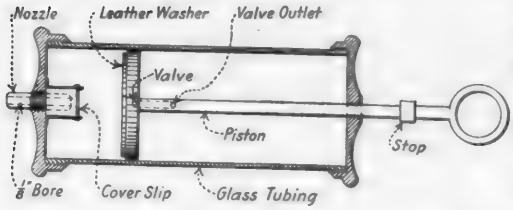


FIG. 16—DETAIL OF HILL DUST COUNTER.

Health Department and by the Chicago Commission on Ventilation during the past winter with very satisfactory results.

METHOD OF USING NEW DUST COUNTER.

In using the instrument the cover of the capsule is removed from the base and a clean ⅜ in. microscopic cover glass inserted in the holder that is provided. The cover glass is then smeared lightly with a mixture of Damar varnish, glycerine and linseed oil of such a consistency that it will not dry or form a surface film when the instrument is in use but will become firm within twenty-four hours. The cover is replaced on the base of the capsule which is then screwed on to the nozzle of the pump. A certain number of strokes with the pump is now taken in the air where the determination is to be made, the number of strokes varying with the extent of dustiness expected. Care in this regard must be taken, an excessive amount of dust on the slide makes it difficult to count. In an ordinary office or school room about 5 to 10 strokes are all that are required. Outdoors, where the air is reasonably clear, 15 or 20 strokes are necessary. After the necessary number of strokes has been taken the capsule is removed from the base. The base is held inverted during this operation so that no dust particles in the air will settle on the specimen. The cover slip is removed from the holder in the inverted position and placed on a clean microscopic slide with the adhesive side against the slide and the specimen placed on the stage of the microscope and a count made. The microscope should be equipped with a No. 3 objective and a No. 1 eye piece, in which is placed the ruled ocular, supplied with the instrument.

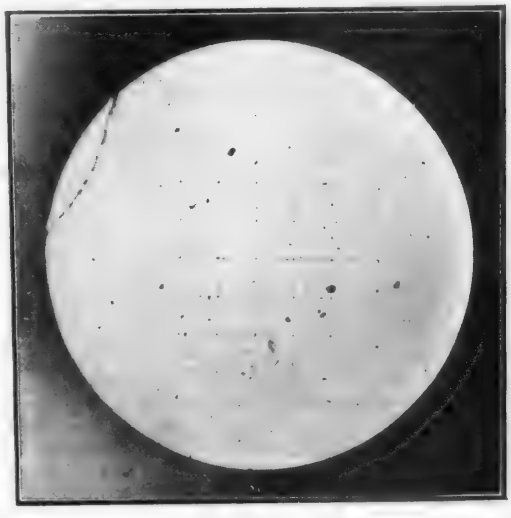


FIG. 17—DUST SAMPLE TAKEN ON STREET CAR BY HILL DUST COUNTER.

As the capacity of the pump is 4 cu. in., each stroke represents 4/1728 of a cubic foot. The operation of counting is simplified without material loss in accuracy by counting only those particles within the limits of the square of the ocular. This, however, necessitates the further correction of 80.8% of the total number of dust particles retained on the cover glass. This gives us a correction factor of 50.096% as the total amount of dust that is retained on the cover glass. The formula, therefore, is as follows:

$$D = \frac{480^{*} \times 2 \times c}{N}$$

when D = dust particles per cubic foot.
C = count in one square.
N = number of pump strokes.

* Capacity of pump 1/432 becomes 1/480 on test, owing to pump leakage and space occupied by plunger rod.

During the past winter we have made several hundred tests with this instrument and have found the results, without exception, consistent and satisfacory. With very simple instructions any ordinarily intelligent person can collect

samples and make the count in a satisfactory manner. Not only is it possible with the instrument to accurately determine the number of dust particles, but a study of the *kind and character* of the dust under observation is often instructive and valuable. This feature greatly enhances the value of the method and makes the work extremely interesting. Counted by this method the particles in clean, outdoor air average from 500 to 1,500 per cubic foot. In a mechanically-ventilated school room, without air washers or other air cleaning device, from 10,000 to 30,000. It is also a practical method for testing the efficiency of air washers. For this purpose a "Y" connection is used on the pump and two capsules used simultaneously, one at the proximal and one at the distal end of the washer, connections being made to the pump with rubber tubing.

NEW TESTS OF DUST REMOVAL BY AIR WASHER.

Some experimental results obtained by two students of the Armour Institute of Technology in work of this kind are of interest. Mr. Otto Armspach and Mr. E. W. Haines made these tests in preparing their graduation theses for their degrees. The tests were conducted during March and April of the present year on a Webster air washer * (shown in Fig. 18) in the experimental laboratory of the Ventilation Division of the Chicago Health Department. Aside from a large number of tests of various kinds which they will shortly publish in their theses the following is of interest:

QUANTITATIVE DETERMINATIONS OF VARIOUS KINDS OF DUST REMOVED BY AN AIR WASHER.

	Medium.	*Heavy.*
Lamp Black	89.4	91.2
Rubber dust	90	92.3
Street dust	96.2	98.2
Wood dust	96.5	99.2
Grain dust	98.5	99.2
Rattler dust	99.5	99.7

The "Medium" and "Heavy" at the head of the two columns refers to the amount of dust that was liberated in vicinity of the intake of the washer. These are the only tests of this character that the writer knows of in the literature of air conditioning work.

* Furnished through the courtesy of William G. Braemer, then manager of the air conditioning department of Warren, Webster & Co.

FIG. 18—EXPERIMENTAL EQUIPMENT USED BY CHICAGO VENTILATION COMMISSION, CONSISTING OF AIR WASHER ARRANGED FOR TESTING BY VARIOUS METHODS.

A statement previously advanced by the writer is brought out clearly in these tests, viz.: that the per cent of efficiency in dust removal of an air washer increases directly with the amount of dust entering the washer. In every instance these tests show the per cent of removal higher when the quantity is "heavy."

In conclusion, the writer would emphasize the statement made at the beginning of this paper, viz.: that with any method of dust determination the results are relative only, they cannot be absolute. This is due to the fact that a considerable number of the minute dust particles that are always present are not caught in the liquid when dust is colleced by bubbling through water but pass through with the bubbles, the amount retained increasing as the size of the bubbles and velocity of air passing through the liquid decreases. We have repeatedly drawn room air through a Drechsel bottle with a 3-in. water seal and counted as high as 7,000 small particles per cubic foot that were not retained in the water. Air passed through four wash bottles in series still gives a light beam with the diffractoscope. On the other hand, while much of the dust that passes through the wash bottle can be collected and counted with this latest dust counter, even with this instrument some particles are so small that the magnification used does not reveal their presence.

Comparison of Pipe Coils and Cast-Iron Sections for Warming Air

By PROF. JOHN R. ALLEN.

(Abstract of paper read from manuscript at the recent annual meeting of The American Society of Heating Engineers and published in the society's Journal for April, 1917.)

Data for the desinging engineer as to the comparative effects of pipe coils or cast-iron sections as types of radiation, which will be useful in laying out a ventilating system, were presented, based on an entirely new set of experiments, as far as the results on pipe coils are concerned, made at the Research Laboratory of the American Radiator Company, in Buffalo, N. Y. The conclusions reached are:

1. The condensation in pounds per square foot per hour for both pipe coils and cast-iron surfaces depends, in properly-designed surfaces, upon the friction of the coil, and

2. The friction of pipe coils varies as the velocity to the 1.9 power and, in cast-iron sections, as the square.

APPARATUS USED.

The experiments on pipe coils were made with an American Blower Company No. 25-A pipe coil, with 1-in. pipes spaced 2¾-in. on centers, with pipes 5 ft. and 5 ft. 3 in. in height. Each section contained four staggered rows of pipe, making 192.55 sq. ft. per section, with a free air area as measured between the first row of pipes of 17.1 sq. ft.

The illustration of the pipe coils (Fig. 1) shows the covering used to protect the thermometers from radiant heat. It also shows the piping used to obtain the static pressure on the inlet side of the coil. An inclined platform 4 ft. long, was placed in front of the coils and a similar one after the coils to prevent the air currents ordinarily produced by the base of the coil.

Figs. 2 and 3 show the piping connections to the coils, the steam separator, manometer for measuring the resistance of the coil, the steam guage, and the

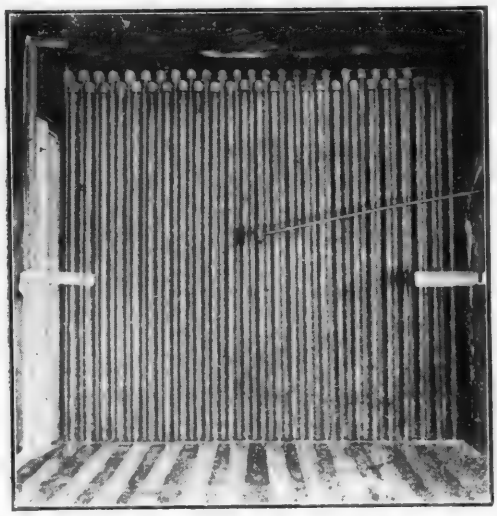


FIG. 1—HEATING COILS IN TESTING CHAMBER.

steam-jacketed tank for collecting condensation. The water level was maintained constant in this tank during the tests, as nearly as possible.

Fig. 4 shows the air-discharge piping connecting the coils with the fan, the location of the Pitot tube and slant gauge, and the board used to locate the Pitot tube positions at which the readings were taken. Forty readings of the manometer were taken for each test and averaged.

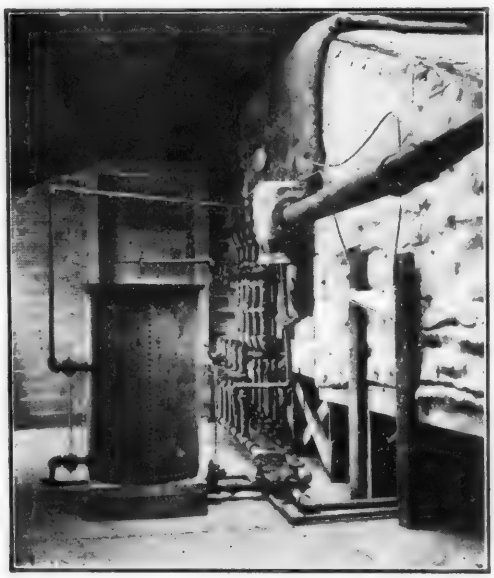


FIG. 2—PIPING CONNECTIONS TO COILS AND CONDENSATION TANK, AND MANOMETER.

Fig. 5 shows the weighing barrels located on the floor below in which the condensation from the coils was weighed. The condensation was collected in one barrel while the weight was being taken in the other barrel, so that the weighing could be done accurately, and the weights were checked at 15-min. intervals.

Before starting the tests, the coils were put under steam pressure and carefully examined to see that they were hot all over and not air bound at any point. The velocity of the air through the coils was adjusted by means of the speed of the fan and the adjustment of the dampers. The air velocities were measured by means of a Pitot tube and manometer. The velocity determined by the Pilot tube was checked with the velocity determined from the condensation of steam in the coils. In most of the tests these velocities checked within less than 1% and in all cases in less than 5%. In making the final computations the velocities as determined from condensation were used.

FIG. 3—STEAM-JACKETED CONDENSATION TANK, SEPARATOR AND STEAM GAUGE.

Table 1 shows the principal average results from the different tests. From the results of these tests Fig. 6 has been constructed.

FIG. 4—AIR CONNECTION BETWEEN COILS AND FAN, PITOT TUBE, SLANT GUAGE AND LOCATION BOARD.

The velocities shown on this chart are for the new free area of the A.B.C. coil. These areas are taken on the diagonals between the two staggered rows and are two-thirds of the area taken between the pipes of the first row. The velocities on the chart are therefore 50% more than if the area is taken between the pipes of the first row, which is the usual custom. In fact, as this paper shows, it is not material where the free area is taken, as the effectiveness of the coil depends primarily upon the friction in this type of heater and not upon the velocity passing through the coil. This fact is pointed out as different manufacturers differ in their practice in regard to the measuring of free air area. If

FIG. 5—WEIGHING BARRELS.

TABLE 1.—RESULTS OF TEST ON 1-IN. PIPE COILS, 2¼-IN. CENTERS.

Date of test—1916	Nov. 23	Nov. 24	Nov. 24	Nov. 24	Nov.26	Nov. 26	Nov. 26	Nov. 28	Nov. 28	Nov. 28
Number of test	1	3	4	5	6	7	8	9	10	11
Number of stacks or sections deep	5	5	5	5	3	3	3	1	1	1
Friction, in. of water	.417	.120	.240	.540	.330	.220	.110	.108	.068	.030
Velocity of air, ft. per min. at 70° F.	1045	542	768	1196	1181	955	695	1189	947	655
Steam temp. in heater	223.25	226.90	225.75	222.44	225.60	226.25	226.70	227.60	226.00	227.16
Temp. entering air, deg. F.	58.94	49.44	43.56	38.80	32.94	36.06	39.50	46.69	46.63	49.50
Temp. leaving air, deg.	126.06	140.90	126.44	112.40	83.25	89.16	97.44	63.34	64.44	70.16
Temp. rise, deg. F.	67.12	91.46	82.88	73.60	50.31	53.10	57.94	16.65	17.81	20.66
Total condensation, lbs.	1342	949	1221.5	1685.3	1140.5	974.0	773.0	380.5	324.0	260.0
Condensation per sq. ft. per hour, lbs.	1.393	.986	1.270	1.750	1.974	1.685	1.338	1.975	1.683	1.350
Total heating surface, sq. ft.	962.75	962.75	962.75	962.75	577.65	577.65	577.65	192.55	192.55	192.55

Each stack—four rows deep by 25 pipes wide; free area, sq. ft.—17.1.

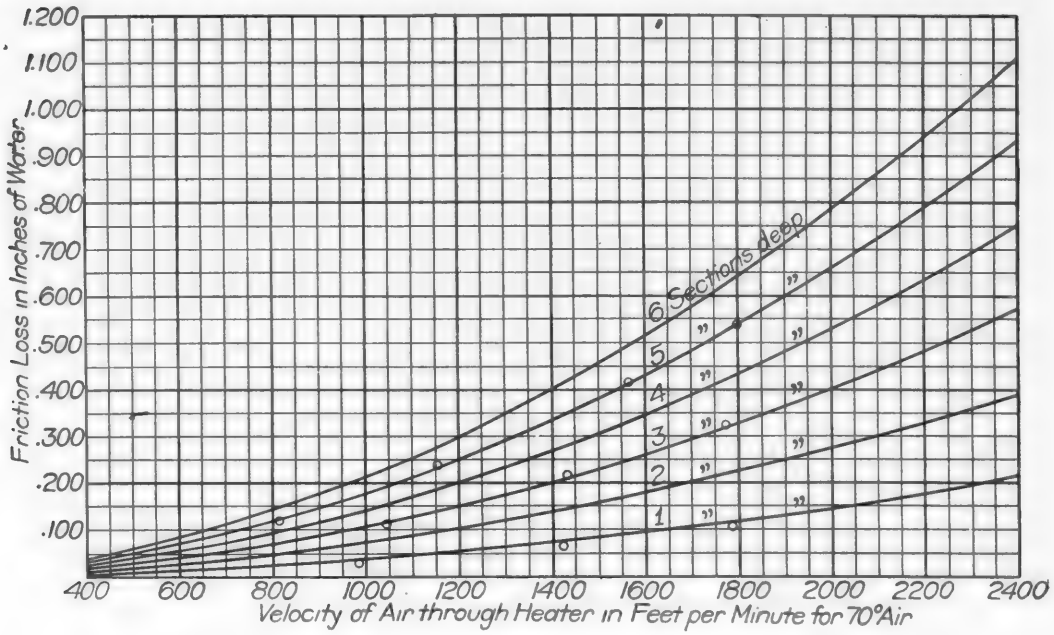


FIG. 6—FRICTION CHART FOR 1-IN. PIPE COILS BASED ON THEIR FREE AREAS.

two-thirds of the velocities shown in the tables are taken, instead of the velocities given, then the results shown on the charts will be for velocities where the free air area is taken as the area between the first row of pipes. This applies to all the pipe coil figures and tables except Fig. 7.

Fig. 7 shows the temperature of the air leaving the coil with the air entering at zero temperature. Velocities in this figure are for free air areas taken be-

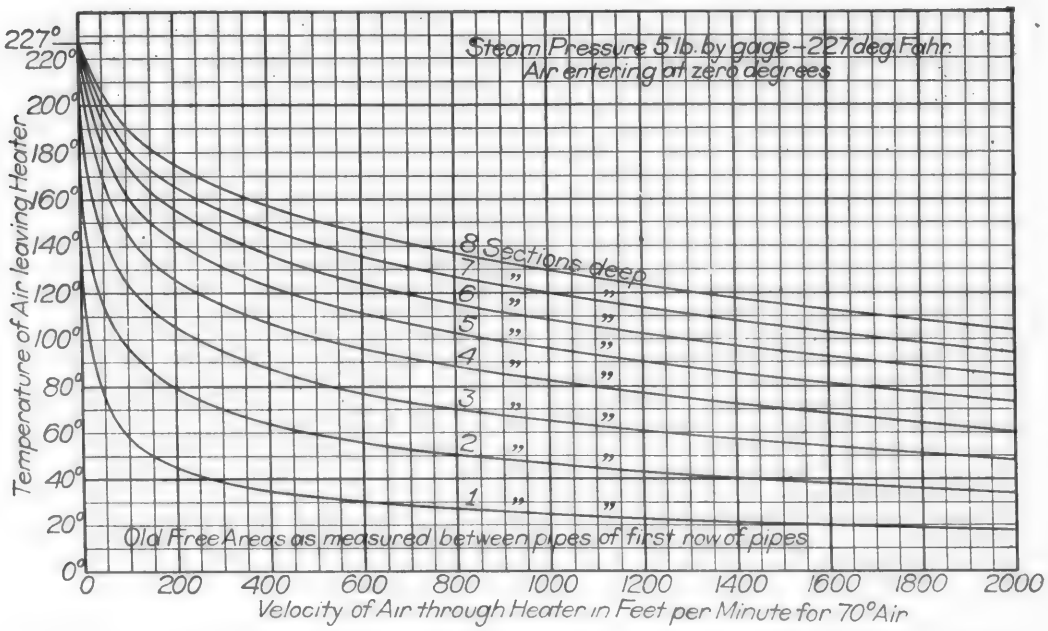


FIG. 7—TEMPERATURE CHART FOR 4-ROW PIPE COILS WITH 1-IN. PIPES SPACED ON 2¾-IN. CENTERS.

tween the first row of pipes and the figure gives the rise of temperature that would be obtained for different numbers of stacks at varying velocities through the coil.

(Tables were also presented showing the final temperatures and condensations for different velocities and numbers of stacks, with pipe coils carrying steam at 227° F. and different entering air temperatures.)

The velocities for the actual tests were computed from the condensation. The condensation was computed for intermediate points for different velocities by the following expression:

$$S \times N \times C \times L = V \times a\ (t - t_1) \times 0.24 \times 60 \times 0.07495 \quad \ldots\ldots (1)$$

where S = square feet of heating surface per stack,
C = condensation per square foot per hour (L.B.S.),
L = latent heat = 970.7 B.T.U. for 227° F.,
V = velocity in feet per minute,
$t - t_1$ = rise in temperature,
a = free area in coil on the diagonal = 17.1 × 2/3,
N = number of stacks,
0.24 = specific heat of air,
0.07495 = weight of 1 cu. ft. of air at 70° F. and a barometer of 29.92 in.

The heating surface in one stack amounts to 192.55 sq. ft. Simplifying equation (1) and solving for C, the equation becomes:

$$C = \frac{1.079 \times 17.1 \times 2/3}{192.55 \times 960.7} \times \frac{V\ (t - t_1)}{N}$$

$$= \frac{V\ (t - t_1)}{15037 \times N} \quad \ldots\ldots (2)$$

Assuming any velocity and range of temperature the corresponding condensation has been obtained for any number of stacks from the expression equation (2).

(The results, as given in the author's tables, check very closely, he states, with the results given by L. C. Soule in Vol. XIX of the Society's Transactions. For the convenience of the reader in making comparisons tables were also included for Vento cast-iron sections.)

Using the same notation as for the pipe coil, the expression for the condensation in the cast-iron section becomes

$$C = \frac{V\ (t - t_1)}{13130 \times N} \quad \ldots\ldots (3)$$

By the use of logarithmic plotting paper it is possible to combine the results from tests on pipe coils with those on cast-iron sections in one chart and this chart can be used to obtain any quantity desired for both cast iron and pipe coil surfaces. Fig. 8 is a logarithmic chart showing results of these tests plotted on logarithmic paper for both pipe coil and Vento surfaces on the same sheet. This figure shows graphically many things that would not be easily observed from the tables. Fig. 8 is divided into two parts, the left-hand half of the figure showing the results for 1-in. pipe coils on 2¾ in. centers, as obtained from the tests just made. The right-hand half of the figure shows the same results for cast-iron surfaces. These Vento results were taken from the tests made by L. C. Soule and have been checked on these charts.

On the left-hand side of the chart the figures shown are for velocities passing through the coil. These velocities are also shown on the right-hand side of the chart. On the line dividing the two parts of the figure is given the condensation in pounds per square foot. This line can be used either for pipe coil or for cast-iron surface. The lower line gives the friction resistance in inches of water—on the left-hand side for pipe coils and on the right-hand side for the cast-iron radiation. The upper line

shows the differences between the air entering and the air leaving the surfaces —on the left-hand side for the pipe coil and on the right-hand for the cast-iron radiation.

USE OF CHART

In order to explain the use of the chart, we will take an assumed case. With five stacks and an entering temperature of—30° F., leaving temperature for a 1200 ft. velocity is 89°, making the difference between entering and leaving air 119°. Now referring to the dotted lines on Fig. 8a, the horizontal line for 1200 ft. velocity intersects the vertical line representing 119° at the point A. From the point A, draw a line at 45° until it intersects the vertical line for five stacks. From this point of intersection, extend a horizontal line to the center line of the chart and we see that the condensation is 1.89 lbs. The resistance is obtained by extending the horizontal line for 1200 ft. velocity until it intersects the diagonal line for five stacks; a vertical line from this intersection shows that the resistance is 0.25 in. of water.

Let us assume a similar case for cast-

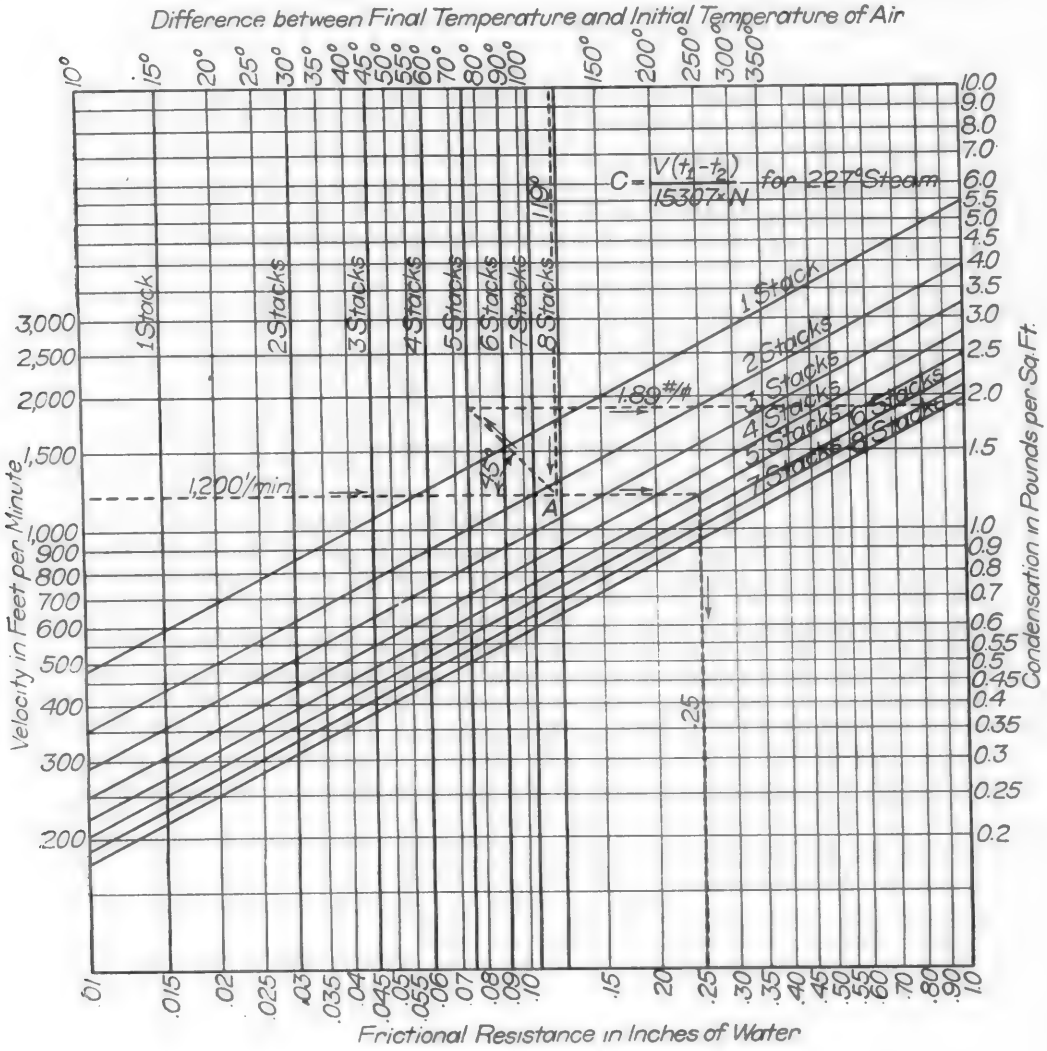


FIG. 8-A—RESULTS OF TESTS OF PIPE COILS.

iron radiation. Take the same resistance (0.25 in.) on the right-hand side of the chart and extend a vertical line until it intersects the diagonal line for five stacks. From this point carry a horizontal line until it intersects the line for increase of temperature of 120°. From this point carry a 45° line until it intersects the vertical line for five stacks. From this point of intersection extend the line to the center line of the chart and the condensation will be seen to be a little over 1.9 lbs. The horizontal line from the intersection of the 0.25 friction line and the diagonal for five stacks, carried to the right, shows that the corresponding velocity in the cast-iron surface is 1068 ft. per minute.

CONCLUSIONS

It will be noticed in comparing the examples for pipe coil and cast-iron surfaces that similar resistances give almost the same condensation. If the difference in temperature in both cases had been taken as 119°, the condensation would have been almost identically the same; it would vary in the two cases by less than 2%. Velocities are, however,

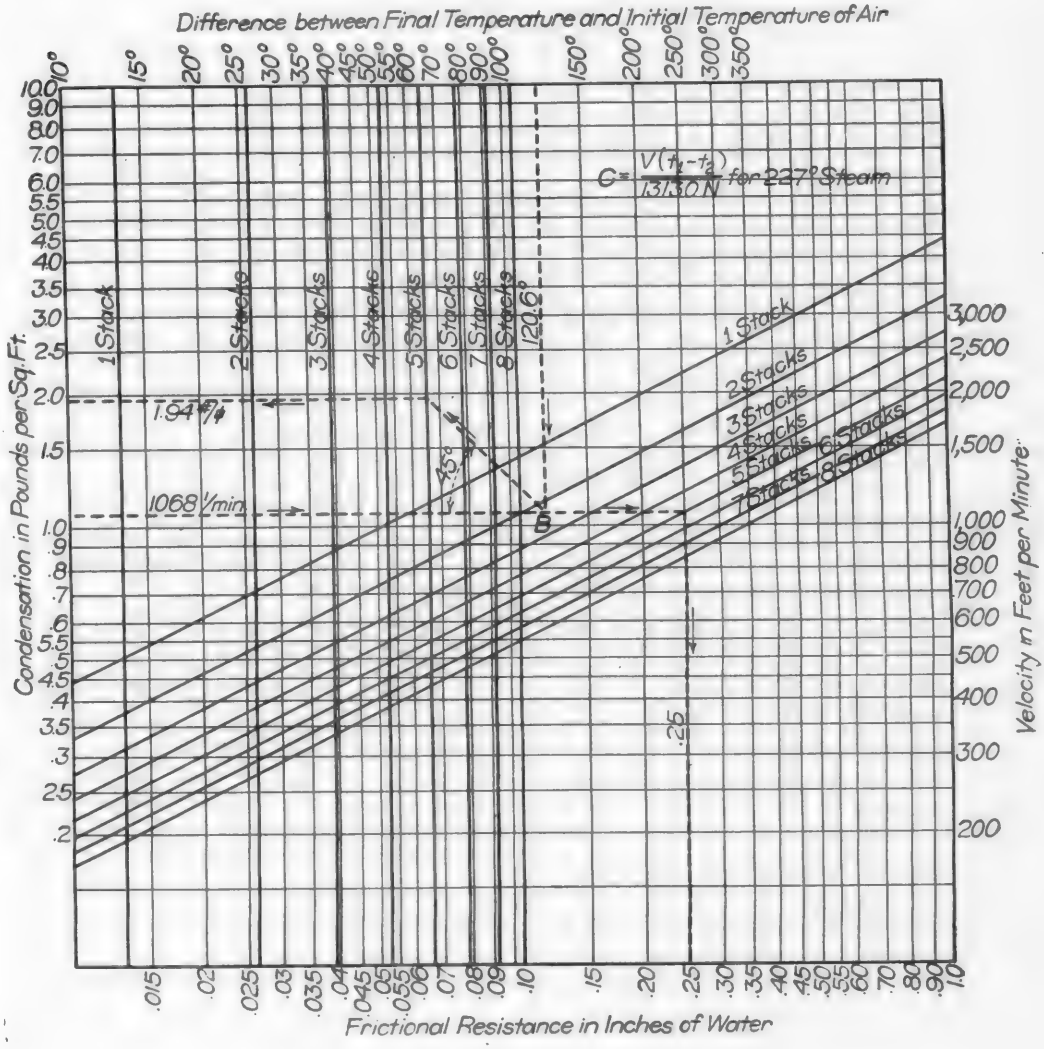


FIG. 8-B—RESULTS OF TESTS OF VENTO HEATERS.

quite different, the cast-iron surface having a velocity of 11% less than the pipe coil. If this same operation is repeated for a great many different conditions for both pipe coil and cast-iron surfaces, it will be found that in all cases equal frictions give almost identical condensations, while, as the friction varies as the 1.9 power of the velocity, the velocities will necessarily show considerable variation. The condensation of a coil is the measure of its heating effect and the efficiency of a coil is approximately 100%. This figure, therefore, shows, that the heating effect of a blast heater surface, properly designed, depends upon the friction of the coil and not upon the catalogue velocities, and that in properly-designed coils it is better to compare various coils by their friction losses than by velocities and free air areas.

For the designing engineer it would be better to assume friction in selecting a coil than to assume velocity. This being the case, it is immaterial where the free area of a coil is taken, as the friction depends upon the volume of air passing through the coil.

Fig. 8 also shows the relation between the velocity of the air and the friction.

It is, of course, possible to construct a poorly designed heater either in pipe coil or cast-iron sections in which condensation will not be proportional to friction. In one case, the areas in the coils might be so open that the air could pass through the coil without being materially heated. It is also possible to construct a coil in which the friction would be excessive, in which case there would be a loss of effectiveness due to excessive eddy currents. In any coils properly designed the condensation should be proportional to the friction through the heater and were it possible to construct a perfect design of coil, this relation would be absolutely true.

In the design of ventilating systems many engineers and architects have not given sufficient attention to the friction of air passing through the heater. The results of this paper would seem to show that the friction through the heater is the most important consideration in the selection of a heater. Good practice requires that the friction of the heater should not exceed more than one-half the total pressure produced by the fan. If the heater friction is too high, excess pressure must be produced by the fan to overcome this friction, requiring additional power to drive the fan. This additional power means an extra charge which is an operating expense and must be paid throughout the whole operating life of the plant. If the friction is taken too low, then the coil becomes ineffective and a much larger coil must be used than is necessary to produce the heating effect desired. The heating resistance of the heater should be proportioned to the piping resistance or to the total pressure produced by the fan. The exact proportion that should be used has, as far as the author knows, only been roughly approximated.

Explosions in Enameling Ovens.

As a result of a number of serious explosions in enameling ovens, both gas and electric, throughout the country, the Ford Motor Company has carried on a series of experiments in an effort to find some reliable means of preventing such explosions.

These explosions usually occurred in the large pipes used for supplying air to the gas furnaces. It was found that these resulted from gas backing up into the air pipes, even though supposedly adequate check valves had been installed at the proper points.

The means taken to overcome the damage done by these explosions are described in *Safety Engineering*. Paper drums were placed over suitable heads at frequent intervals along the main pipe lines and these were found to provide sufficient outlet to prevent any serious consequences in case of explosion.

The success of this plan led to its trial on the ovens. Two holes, each 3 ft. square, were cut in the top of a large enameling oven and ¼-in. plates placed over the holes. The oven was then filled with gas and

exploded with an electric spark. The plates were blown 30 ft. into the air, while the small latch holding the doors shut was broken and the doors hurled back with great force. The explosion proved that the holes in the top of the oven were not sufficiently large to take care of the explosion without damaging the oven.

REMEDY FOUND IN LOOSE TOP.

To correct that difficulty the top was loosened, but still allowed to rest in its usual position. The doors were strongly secured. Several explosions were made and the top lifted from 3 in. to 15 in., varying with the force of the explosion. The top weighed approximately 7 lbs. to the square foot. None of these explosions injured the oven, while the pressure on the doors was not heavy. With the top fastened down, however, and all other outlets stopped, the oven would have been wrecked.

These experiments were all carried out under the direction of the Ford factory superintendent and proved so satisfactory that he ordered all Ford enameling ovens changed so that, in case of explosions, the tops will lift and dissipate the force of the explosion without damage to the ovens.

How to Build Houses To Retain Heat.

When a man builds a house in which he is likely to spend a half or more of his days, it is a matter of some little importance to him that it be built well—not merely that it be built so that it wll not fall down, but so that it will leak neither water nor weather. A leaky house is a misery and a misfortune. It is almost sure to be a permanent liability.

In building remember that no roofing is too good to cover your head. He who thinks to save money by using a cheap grade of shingles has much to learn at large cost. Shingles are not necessarily right because made of West Coast cedar, not because marked "Extra Star A Star." Before you buy shingles for your house, have the lumber merchant show you samples of all his stock. If he has a large variety, and something ultra good, order the best he has. A "thick clear" red cedar shingle on a not too flat roof will be found one of the most satisfactory roofings ever put on a dwelling.

DON'T EXPERIMENT WITH ROOF.

There are other good roofs, some of them better than shingles, perhaps, but if you don't know how good they are, insist on seeing the material and on interviewing men who have used them before trying an experiment with them yourself. A leak in a roof is one of the most prolific causes of a chronic profane temper in the householder. A leak in the roof is worse than a rat in the walls, harder to locate and harder to be rid of.

There is also a science in the laying of roofs. Study that seriously before your roof is laid and see that it is laid scientifically. A careless or dishonest workman may make a bad roof of the best roofing material.

Next to water leaking through the roof, your worst elemental enemy is wind. Weather leaks through the siding and about the windows and doors are leaks in your purse. It is not an uncommon thing in any city for a householder to throw two tons of coal every winter through the cracks in his house.

Two tons of coal at $10 a ton is equal to the interest at 5% on $400. Forty dollars added to the cost of material and labor put into the leaky house would have saved all this coal. When you are planning your house take a day off and look at all the varied kinds of felts and papers, fixtures and fabrics that are on display designed to "stop a leak to keep the wind away." Among them you will find something vastly superior to the old tar paper and back plaster, and something that will probably cost you no more money. Remember this, that builders these days know better how to build a weatherproof house than they did 20 years ago. Don't let any behind-the-times contractor build your house.

Here is something worth remembering. An attic floor with insulation is one of the best fuel savers ever devised. Build two houses side by side just alike except that one has an attic fioor insulated and the other no attic floor at all, and when snow is on the city roofs and temperature at a certain point, you will see the snow melt on one of the roofs and not on the other. The coal bill in one will be larger than in the other. It costs money to melt snow on your roof.

If you buy a house already built assure yourself that its roof is waterproof and its walls weatherproof. Know that the man who built it is an honest builder. If ever you find yourself obligated to pay for a home with unmendable leaks in it the knowledge of the leaks will cut down your enjoyment of the home even more than the leak will drain your purse. Any construction that will save fuel is cheap, for fuel will be continuously dear. Two tons of coal a year will pay the premium on a snug little life insurance policy.

THE HEATING AND VENTILATING MAGAZINE

A Monthly Journal of Engineering Progress

Vol. 14 June, 1917 No. 6

Published Monthly at Cooperstown, N. Y., by the

Heating and Ventilating Magazine Co.

Executive and Editorial Offices, 1123 Broadway New York

A. S. ARMAGNAC ..... *President*
GUSTAVE PETERSEN.... *Secretary and Treasurer*

A. S. ARMAGNAC, Editor
GUSTAVE PETERSEN, Business Manager
HAROLD L. ALT, Contributing Editor

European Representative:
W. G. HOLLINWORTH, 304 High Holborn London, W. C.

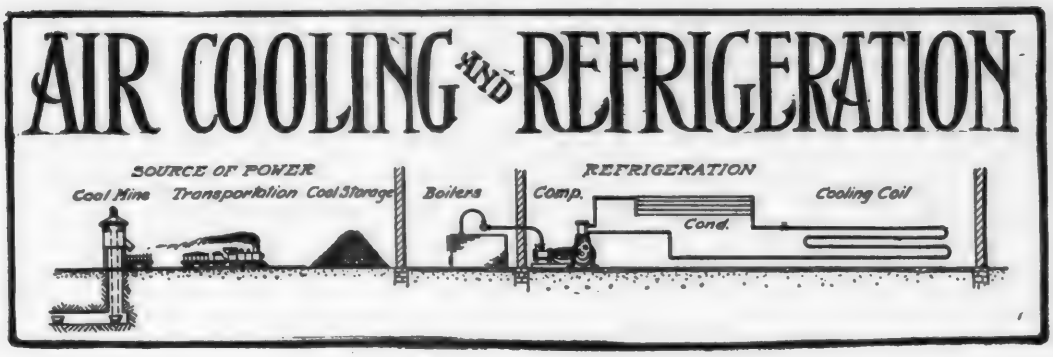
Subscription	$1.00 per year
Canada	1.25 " "
Foreign countries	1.50 " "
Back numbers	15 cents each
Back Nos. prior to current year	25 cents each

HEATING engineers will be called upon sooner than expected for war service, as a tremendous problem has already arisen in connection with the drying of fruits and vegetables. Due to the scarcity of tin, the manufacture of tin cans, it is announced, has come practically to a standstill and means must be found at once for drying such foodstuffs on a large scale. It is stated that the drying of fruit and vegetables is well understood abroad and has had an important bearing on the prolongation of the war. According to this information there are three types of apparatus in use, one for the household, a larger plant for community service and a still more elaborate outfit for the regular, organized drying industries. The product is packed in paper cartons and in this form may be readily transported and stored. The possibilities of the food-drying industry have long been understood but with the conditions brought about by the war emergency to spur it on, this industry is likely to develop to imposing proportions, especially when it is considered that the operation of such units will require almost as much skilled attention as their design.

A SIGNIFICANT step was taken recently when conference committees of the National District Heating Association and of The American Society of Heating Engineers met together to discuss ways and means for a closer co-operation between the two organizations. There has been considerable co-operation in the past, but if the present plans are carried out, we may expect to see shortly a joint professional meeting which would undoubtedly have important results. The truth of the matter is that while the two associations are sufficiently distinct in scope and purpose to justify and really require different organizations, there are many points on which their interests are identical. The principal reason for a separate organization is the so-called "commercial" character of the district heating engineers' association, as compared with the more technical character of the "American society." From the point, however, where the heating medium leaves the distribution main and enters the building the problem becomes one of heating pure and simple and here the interests of the two bodies are the same. It would seem that nothing but benefit for all concerned could result from a closer co-operation of the two societies.

ON ACCOUNT of the abnormally cold May, during which heating plants generally were continued in operation, the monthly weather charts appearing regularly in THE HEATING AND VENTILATING MAGAZINE during the heating season, will include May this year. The May charts will appear in the July issue.

AIR COOLING AND REFRIGERATION



Elements of Refrigeration

The process of refrigeration is closely analogous to that of heating, the principal difference being that the medium used for refrigeration vaporizes at a much lower temperature than the water used to produce steam. While there are several agents which are used for refrigerating purposes there are general essentials which make a gas desirable and certain objections which accompany each gas which make it more or less undesirable.

For instance, *anhydrous ammonia* (which is most commonly used for this purpose) boils or vaporizes under atmospheric pressure at 28° F. below zero. Its main objection lies in the fact that its gas is dangerous to human life. *Carbon dioxide*, which is another agent sometimes employed, has the advantage of being non-explosive, non-inflammable and is not dangerous to human life unless in excessively large quantities. It has the disadvantage, however, of boiling or vaporizing at a very low temperature (this being 110° F. below zero) which results in requiring a very high pressure in order to liquefy it. When used, this gas must be compressed to 750 or 1,000 lbs. per square inch, which requires excessively strong piping and expensive apparatus. The agent itself is non-corrosive and, together with ordinary air, is considerably used for cooling on shipboard. *Sulphur dioxide* has a boiling point of 14° F. below zero which is a very desirable temperature and will liquefy at a much lower pressure. Its chief disadvantage is its lightness requiring large and cumbersome machinery to compress the cubic footage required, owing to its high specific volume.

For purposes of discussion the most common agent, namely anhydrous ammonia, will be assumed as the agent although the other gases follow a similar cycle of operation, except with varying temperatures and pressures according to the agent employed.

COMPARISON OF HEATING AND REFRIGERATING PROCESSES.

To draw the parallel more closely between heating and refrigeration the reader is referred to Fig. 1 in which A indicates a steam boiler partially filled with water at atmospheric pressure under which conditions the boiling point will stand at 212° F. Owing to the outside atmosphere surrounding this boiler being of a lesser temperature than 212° it is necessary to raise the temperature of the water to its boiling point in order to vaporize it, this rise in temperature being artificially produced by the building of a fire beneath the boiler under which

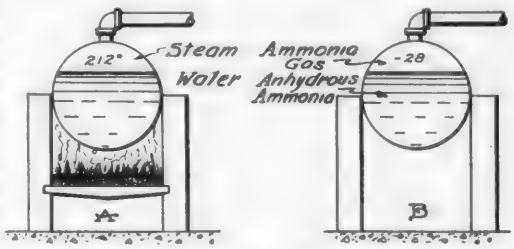


FIG. I—COMPARISON OF HEATING AND REFRIGERATING PROCESSES.

conditions the water is raised to 212° and steam is produced. Now in B assume that the boiler is filled with anhydrous ammonia which, as already has been seen, has a boiling temperature of 28° F. below zero. The only difference between this boiler and the first one is the fact that the atmosphere surrounding the boiler contains sufficient heat to boil the liquid without the use of the fire. Therefore the ammonia vaporizes and turns into ammonia gas just as water vaporizes and turns into steam.

If it was necessary to build a fire underneath the water in order to supply the latent heat required for vaporization, it is self-evident that the heat furnished by the fire would be absorbed by the water and steam in the process of vaporizing, this being termed the "latent heat of vaporization." When the ammonia vaporizes a similar action takes place; that is to say, latent heat to the extent of 573 B.T.U. per pound, is absorbed in the vaporizing of this agent. As the heat, however, in the case of the ammonia was supplied *not by the fire* but by the surrounding *air,* this results in the withdrawal from the surrounding air of a large number of B.T.U. depending upon the quantity of ammonia vaporized and the falling temperature of the air for, of course, when the air temperature is reduced to the temperature of the evaporating ammonia (or 28° below zero) further heat exchange cannot take place and the ammonia would cease to evaporate just as the water in the boiler will stop boiling when the temperature of the fire falls to less than 212°. In reality, however, it is never necessary to reduce the surrounding air to this extreme point and, therefore, the heat which the air draws from some other source continues to be absorbed by the vaporizing ammonia and the process becomes a continuous one.

REFRIGERATING AGENTS EXPENSIVE AND MUST BE RE-USED.

If the refrigerating agents were as cheap as water this vaporizing is all that would be necessary to produce artificial refrigeration, but unfortunately, this desirable feature of cheapness has not yet come to pass and all the complication of refrigeration systems is almost entirely due to the efforts made to preserve and use again the refrigerating medium. If the ammonia gas, after its evaporation, is to be retained and re-used two things are necessary; first, its heat, which it has absorbed in the process of vaporization, must be removed and, second, it must be changed from a gas back to its liquid form ready to begin another cycle.

The most simple process of removing the heat consists of compressing the gas to a very high pressure which is accompanied by corresponding increase in temperature. Reference to the table presented in last month's issue shows the vaporizing temperature for any given pressure; thus a steam boiler operating under 100 lbs. pressure requires a certain temperature to evaporate water, this temperature being much higher than when operating under atmospheric pressure. So, also, the boiling point of ammonia under high pressure is raised and the problem is simply to produce pressure high enough so that the ammonia will not boil even at ordinary atmospheric temperatures. This increase in pressure is accomplished by means of a piston operating in a cylinder in a manner exactly opposite to that of the ordinary simple steam engine. In the steam engine steam comes in as a gas compressed under more or less of a high pressure and expands behind a piston driving the piston forward and producing power at the flywheel. With the ammonia compressor the ammonia gas enters the cylinder under little or no pressure and is

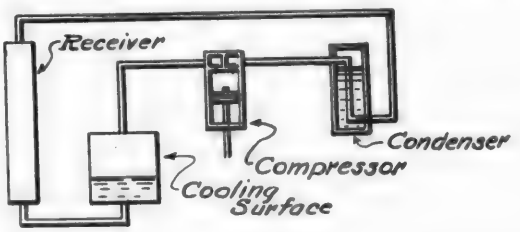


FIG. 2—DIAGRAMMATIC SKETCH OF REFRIGERATING PROCESS.

compressed by the backward movement of the piston which is operated by power applied to the flywheel end; this results in the gas being compressed and driven out through the discharge pipe with a corresponding increase in its temperature.

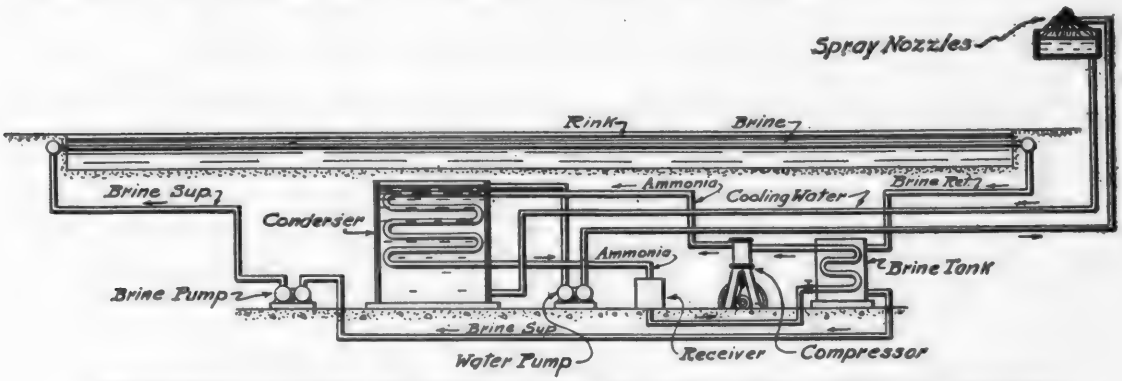
The compressor does not change the gas to a liquid but owing to the great increase in temperature it is possible to cool the gas to a point where the high pressure under which it is compressed will result in its liquification. This is done by passing the high-temperature, high-pressure gas through some sort of cooling surface, which may be pipes exposed to the outside air, pipes submerged in cold water or any other method whereby the sensible heat is absorbed by the cooling agent employed in the condenser; this results in a drop in temperature of the ammonia gas to a point where it condenses and returns to its liquid form. The liquid ammonia thus produced passes into a liquid receiver where it is stored, still under its high pressure, and from which it is admitted through a valve into the vaporizer first illustrated, ready for a second vaporization and a repetition of the cycle.

Fig. 2 gives a diagrammatic sketch of the means above described, the gas vaporizing in the cooling surface and producing refrigeration; it then passes out of the pipe at the top and over to the compressor

where it is compressed and its temperature rises to a high degree; from the compressor the hot gas goes to the condenser where it is cooled by the cooling water and condensed; from this point it flows back as a liquid under high pressure and moderate temperature to the receiver ready to again enter the evaporizer for a second trip.

"DRY" AND "FLOODED" SYSTEMS.

Where all the ammonia is evaporated into ammonia gas and returns to the compressor as such the system is called the "dry" system but where some of the ammonia, after passing through the vaporizer, remains in liquid form and is caught in an accumulator and re-passed through the vaporizer while the gas goes to compressors it is termed the "flooded" system. In the dry system the heat is transferred from the liquid outside of the coils to the gas inside the coils, while in the flooded system the heat transmission is between liquid on both sides of the coil and the transmission, being from liquid to liquid, is therefore much more rapid. For this reason a flooded system will give more rapid refrigeration and require less refrigerating surface but requires a greater initial amount of ammonia.



ARRANGEMENT OF SYSTEM FOR FREEZING ICE IN THE NEW WINTER GARDEN, SAN FRANCISCO.

The cooling of the brine takes place in the brine tank in which is placed an ammonia coil inside of which the ammonia expands and absorbs the heat. The expanded gas is then compressed in the compressor and its high temperature cooled off in the condenser; it then returns into the receiver ready for use. This is an "indirect" system owing to the use of brine in the rink pipes and not ammonia.

The cooling water is kept from overheating by being pumped by the water pump up to a tank on the roof into which it is sprayed.

Notes

Last October the new Winter Garden in San Francisco was opened to the public. This is an artificial ice skating rink 275 ft. long by 144 ft. wide, the ice portion being 210 × 90 ft. The ice in this ring is frozen by brine cooled in a cooling tank by the expansion and vaporizing of ammonia as indicated in the diagram.

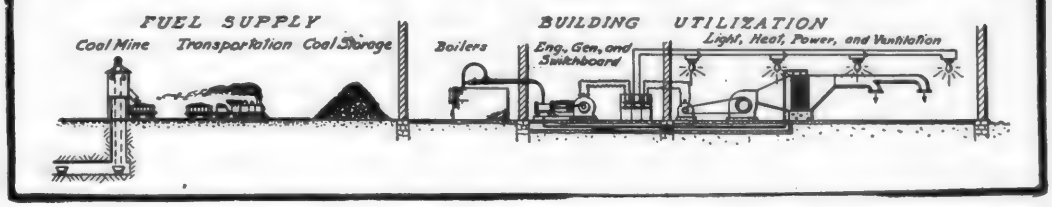
The rink which was constructed under direction of J. T. Ludlow, consulting engineer, of San Francisco and was built over the floor of the roller skating rink which previously utilized the same space. On top of the floor was laid 8 in. of sawdust and water proof roofing, this being covered with a sprinkling of fine sand. On the sand was placed 55,000 lin. ft. of 2 in. steel pipe with a total of only 134 joints, all other junctions being oxy-acetylene welded.

The ice plant consists of two 50-ton compressors operated by 100 H.P. motors, and 2,500 gal. of 75% brine solution are circulated through the rink coils by the brine circulation pumps, the rate of circulation being about 15 g.p.m.

It is endeavored to hold the ice as near 32° F. as possible as this gives the best surface for skating.

Pittsburgh is the proud possessor of a new artificial ice skating rink. This is known as the Duquesne Garden and was secured through the conversion of an old street car barn into a rink of the first water —or ice. This rink is frozen by an ammonia-brine system operated entirely by alternating-current motors.

POWER PLANT ENGINEERING



The Design of a Building Power Plant

In designing a power plant for any building the engineer has a problem on his hands of a considerable magnitude; not so much as to size and capacity, perhaps, as to the making of basic decisions first, regarding fundamental essentials of the plant.

For instance, a power plant means high steam pressure but what shall be selected as a "working pressure" for the plant? And what type of boiler shall be used; firebox, horizontal return tubular, downdraft, water-tube or what? Shall a feed-water heater be used, and, if so, of open or closed type? What kind of engines, simple, compound, condensing or non-condensing? Or shall steam turbines be substituted? Will the generators be direct or belt-connected? What kind and what voltage of current is to be adopted? What heating system is going to be used and how are the returns to find their way back to the boilers? These are only a few of the leading questions which must be finally decided before the design of the plant can be undertaken intelligently.

Other important issues consist of the fuel to be used, the grates or stokers to be installed, whether natural, forced or induced draft is to be selected, size and height of chimney, method of ash handling, method of coal handling, amount of coal storage, the question of economizers, pure feed water, scheme of boiler feeding, devices for accurately testing the plant operation such as water weighers, coal scales, etc.

IMPORTANCE OF SPACE CONDITIONS.

Undoubtedly one of the most important elemental factors is that of space conditions; these may even influence the type of boilers, it often being found that boilers of one type cannot be installed in places where boilers of another style can be used with advantage. In considering space conditions the height should also be looked into and the boiler room ought, by rights, to be two stories high; in some small installations and also in buildings with a high basement the boiler room may be only a single story high.

In high-pressure work it is desirable to take the steam out of the boiler through a high pipe bend (generally of a U-shape) but with a low ceiling connections as shown in Fig. 1 are used; such a layout gives a swing nipple at A and another at B. This type of connection is also used where the horizontal distance between the boiler nozzle and the main steam header is not sufficient to permit the use of a bend.

TYPICAL POWER PLANT EQUIPMENT.

While every building has its own arrangement of power plant equipment, that shown

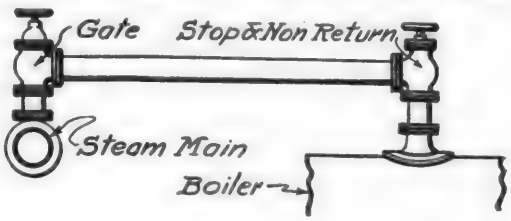


FIG. 1—STEAM PIPE CONNECTION TO BOILER WHEN CEILING IS LOW.

in Fig. 2 may be taken as more or less typical, the main pieces of apparatus consisting of

Boilers
Engines
Feed Water Heater
Boiler Feed Pumps
Back Pressure Valve
Oil Separator
Exhaust Head
Steam Separators
Traps

As far as the boilers are concerned there are several types in use, the three most common types being the fire-box, horizontal return tubular, and water-tube. Without doubt the old reliable H.R.T. is the most popular, in spite of the fact that the brick settings make these boilers more expensive than the firebox type. The steel boiler, without a brick setting, undoubtedly makes the cheapest steam producing unit suitable for power plant use. Down-draft boilers of steel, either brick set or portable, are also good where smoke considerations and cheap coal are essential, but the expense of a stoker unwarranted. For the best work water-tube boilers of Babcock & Wilcox, Heine, or Sterling types are used, these being capable of burning almost any

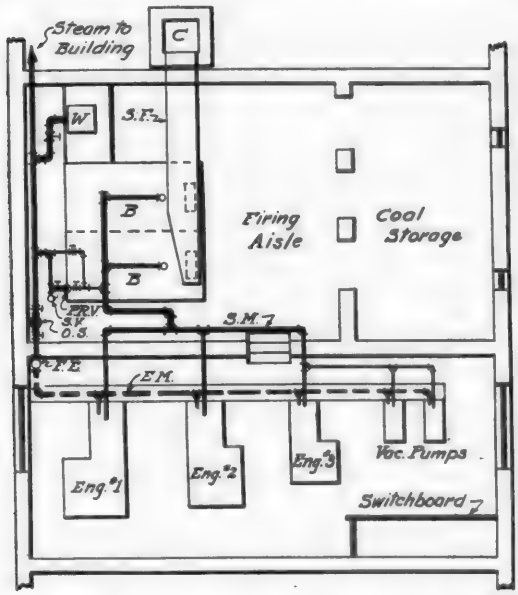


FIG. 2—TYPICAL EQUIPMENT FOR POWER PLANT.

kind of fuel smokelessly when equipped with a good make of automatic stoker.

In general high-pressure boilers may be classified into two classes—fire-tube and water-tube. The fire-tube boilers may be sub-divided into the return tubular (such as the common H.R.T.) and the fire-box tubular in shape somewhat resembling the common locomotive boiler.

INSTALLATION OF AUTOMATIC STOKERS USUALLY JUSTIFIED.

The automatic stoker is a very expensive proposition often costing as much, and sometimes even more, than the boiler to which it is applied. The results attained in the long run, however, will usually justify the cost, especially with the advancing prices of the better grades of coal. Of course, the ideal method of supplying coal to a stoker is from an overhead bin sometimes supplemented by a travelling feed spout but in the small building power plant such refinements are not usually adopted. The coal is most generally stored in bins on the same floor level and is then shoveled by hand into the furnace or stoker. Consideration should be given the fact that the level of a stoker is liable to be 5 ft. to 7 ft. above the floor and that the stoker should either be set in a pit or an elevated shoveling platform provided.

All steel boilers must have space to allow for the withdrawal and replacement of tubes which may become defective later. Space must also be provided for the necessary access doors, and as a general rule it may be said that of all boilers on the market only the H.R.T. can be set in a continuous battery, the water-tube and down-draft can be set in batteries of not over two, and the fire-box should be set singly.

Breeching considerations may sometimes influence a decision on boilers, the water-tube having the uptakes located at the rear and the other types at the front.

Ashes in the case of the use of ordinary grates are, of course, removed from the ash pit. With down-draft boilers the clinkers are pulled from the upper grates and the ashes removed from the ash pit; with stokers the usual procedure is to dump the ashes from the interior end of the stoker down into a steel ash hopper with an iron gate from which the ashes are removed from time to time by opening the gate. From this point the ashes can be transported by means of an ash car, wheel barrow or steam jet system to any point desired. Forced draft is always a desirable accessory to any power plant boiler installation, as it develops a greater boiler horsepower, more quickly, and at small cost, if steam operated. Forced draft cannot be used with chain grate stokers but is an absolute requirement for the underfeed types of stokers. Induced draft is so seldom used in such cases as to make its consideration unnecessary here.

ACCESSORIES NECESSARY WITH HIGH PRESSURE BOILERS.

To operate a high-pressure boiler success-

fully certain accessories and apparatus are necessary; these may be itemized as follows:

(a) Water column, gage glass and try-cocks to indicate the level of the water in the boiler.
(b) A pressure gauge reading to 50% above the operating pressure.
(c) A safety valve set at about 10 lbs. above the normal working pressure.
(d) A blowoff valve and tank with drain to sewer so as to allow the blowing-off of impurities from the boiler water and the emptying of the boiler.
(e) A steam nozzle and steam pipe to carry the steam away as it is produced.
(f) A manhole for access to the interior.
(g) Handholes for cleaning where access is not possible from the interior.
(h) Some sort of apparatus to feed in the water against the boiler pressure—such as an injector, boiler-feed pump, etc.
(i) A furnace or stoker in which to burn the fuel.
(j) A chimney to carry off the gases of combustion.

Besides these certain other features are desirable but not absolutely necessary, such as

(k) Fusible plug which melts when the water line gets below it, and allows the steam to blow out and drown the fire.
(l) High and low water alarms which blow a whistle to notify the firemen when the water line is getting too high or too low.
(m) A feed-water heater to heat the feed water to as near the boiling point as practical so as to subject the boiler to as little temperature strain as possible when being fed with water.
(n) A system of forced draft for quick control of the steam produced.
(o) An automatic damper regulator which controls the draft so as to maintain the steam pressure at a constant point regardless to the size of demand made on the boiler.

The fusible plug is gradually passing out of use in the boilers of better plants, its place being taken by water columns with high and low water alarms.

Notes

One of the most interesting facts in regard to the use of exhaust steam for heating work is the argument and figures of actual coal consumption presented by some investigators showing that it takes less coal to heat a building if the steam is generated at high pressure and passed through an engine before entering the heating system than if it enters the heating system direct through a pressure reducing valve. Theoretically this is all wrong but theory cannot contradict actual facts—if the facts *are* indeed actual.

The data presented in support of this contention, however, seems to be so simple and backed by such substantial sponsers that dispute of the basic fact is difficult. If, on Sunday, with the power plant shut down, it takes a larger quantity of coal to hold up the temperature in a factory than it does on a workday with the same outside temperature, how is it possible to account for the difference? While it is entirely within reason that such a thing might happen once in a while, due to higher winds on Sunday, etc., how can it be explained that that a power plant, added to a heating plant which had been run for years, saved 100 tons of coal during the very next heating season although the average winter temperature was practically the same?

Any of our readers who have any facts on this interesting subject, either pro or con, are asked to send them in for discussion in this department.

The government gives some good suggestions regarding methods of checking up short weight coal deliveries in their "Measurements for the Household" issued by the Bureau of Weights and Standards. Other chapters deal with the theory of heat, heating valves of fuels, various kinds of thermometers, and on the amount of ice melted in various refrigerators tested. Atmospheric humidity, heating of rooms and water, gas and electric meters are also discussed.

Those of our readers interested in smoke prevention will find much useful information in Bulletin No. 39 issued by the Bureau of Mines, Department of the Interior, entitled "The Smoke Problem at Boiler Plants." This bulletin is a preliminary report by D. T. Randall and covers briefly the requirements of the smoke ordinances of various cities and the methods which may be used in endeavoring to comply with same.

Further discussion of the subject is given in Bulletin No. 49 by Samuel B. Flagg in

which proposed smoke ordinances are recommended and the ordinances of several cities quoted verbatim. The smoke question is a vital one in every power plant and should be considered from all angles before a decision is reached as to what equipment is necessary and how exacting are the requirements under which the plant must be operated.

CORRESPONDENCE

Fuel Economy and Humidification.

EDITOR HEATING AND VENTILATING MAGAZINE:

In The Heating and Ventilating Magazine for March, 1917, arguments by Professor William Kent against artificial humidification are presented. The first point which he makes is that there is no resulting economy in heat through ability to maintain a lower indoor temperature. To prove this, he presents a mathematical analysis which is fundamentally at fault at the very start. He assumes that the heat used to generate the moisture required for humidification is lost; in other words, that it is not available for warming the apartment. Upon the basis of this assumption, his figures are intended to prove that the heat saved by reduced radiation, due to the lower indoor temperature of the humidified condition, is less than expended in generating the vapor for humidification.

Kent's conclusions are criticized by Mr. Charles E. Manierre who questions the accuracy of his figures. Mr. Manierre, however, says nothing about what becomes of the heat used to produce the vapor. This is a question which has bothered a great many people. With myself, I found an answer by trying the matter out by actual demonstration. Steam from the heating system was discharged in the air of the rooms by the Steamo air moistener. This steam is not taken from the radiators, but from the branches and risers. In this way the radiators may be used or not as desired, while steam for humidification is always available. The result of my experience has been that during about one-half of the period of a heating season, there is no day that a radiator is turned on. During the other portion of the season there are very short periods during which all of the radiation may be on or all off, but, as a rule, a reduced amount of radiation only is used. The fact is that for a very large part of the heating season, the steam required to produce the humidity desired, also heats the apartment with no heat from any other source. This, I think, is proof that Professor Kent is wrong in his assumption. At all events, it is my advice to any one who wishes to settle the matter for himself to try it.

Some engineers whom I know are now taking this fact into consideration, and specifying less radiation than formerly, planning to get a portion of the required heating effect from the steam liberated for humidification. This is an important matter and one well worth while looking into.

Professor Kent, in reply to Mr. Manierre, states, among other things, that he has lived in a humidified house, also in one that was not, and that he likes the dry air condition best. Professor Kent is considered a very eminent authority and when he makes a statement like this, people are liable to sit up, take notice and wonder what it all means. Especially when his preference is in opposition to physical fact. But I think if we will exercise our minds a little, we can get over the obstacle. As an illustration, it is generally undertsood that the habitual drinking of whisky is not beneficial. Now, if I should say that I preferred to drink it nevertheless, my statement would convince no one that it was a good thing to do. With humidity, however, not so well understood, we are in danger of being influenced by such a statement as that of Professor Kent's.

Chicago, May, 1917. A. B.

Current Heating and Ventilating Literature.

Under this heading is published each month an index to the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the article mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

DRYING

The Theory of Drying and Its Application to the New Humidity Regulated and Recirculating Dry Kiln. 28 pp. U. S. Dept. Ag., Bul. 509—March 17, 1917. On drying of lumber. 50c.

THEORY

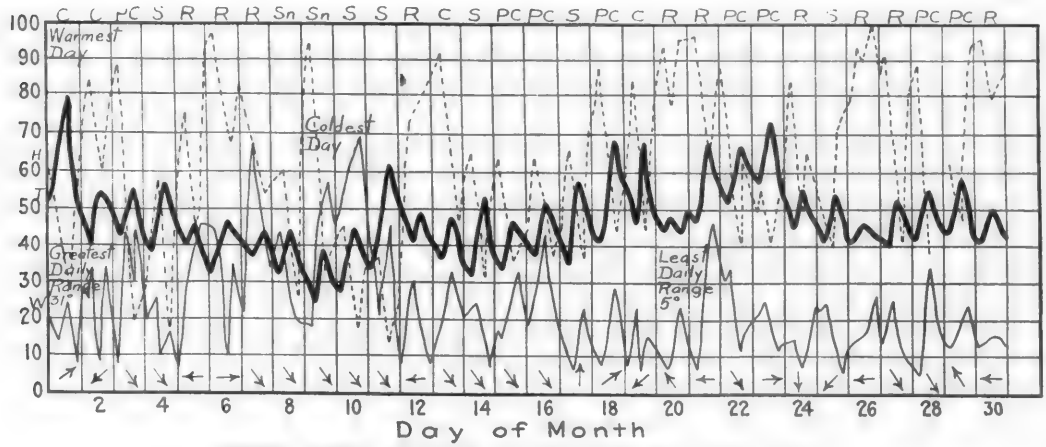
An Outline of the Theory of Heat Transmission and Absorption in Application to Ordinary Engineering Problems. John E. Bell, with discussions. Ills. 49 pp. Engrs' Soc. W. Penn., Pro—Jan., 1917. 60c.

REFRIGERATION

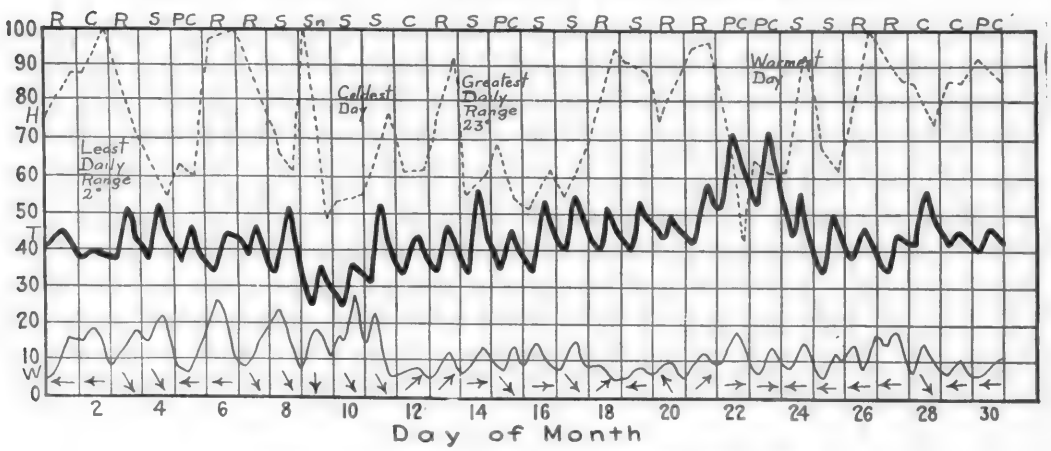
Absorption Plant for Distilled Water Ice. Ills. 1800 w. Prac. Eng., Chi.—March 1, 1917. Equipment of an Indianapolis plant. 20c.

The Weather for April, 1917

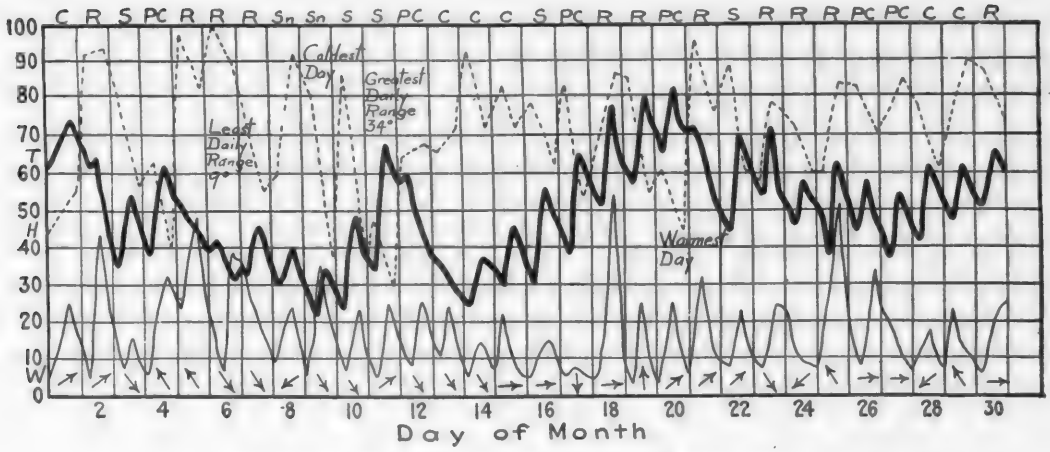
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	79	72	81	82	84
Date of highest temperature	1	23	20	18	23
Lowest temperature, degrees F.	25	26	21	30	30
Date of lowest temperature	9	10	9	13	9
Greatest daily range, degrees F.	31	23	34	31	26
Date of greatest daily range	1	14	11	18	17
Least daily range, degrees F.	5	2	9	2	6
Date of least daily range	20	2	6	7	28
Mean temperature for month, deg. F.	47.2	44	50	44.8	53.7
Normal mean temperature for month, deg. F.	48.1	45.3	51	45.9	56.1
Total rainfall, in.	2.35	2.72	2.20	2.58	4.64
Total snowfall, in.	6.5	9.1	0.7	Trace	..
Normal precipitation, this month, in.	3.3	3.55	2.9	2.88	3.52
Total wind movement, miles	12942	7363	9043	10514	11247
Average hourly wind velocity, miles	18	10.2	12.6	14.6	15.6
Prevailing direction of wind	N. W.	N. W.	N. W.	N. E.	S.
Number of clear days	6	10	6	7	8
Number of partly cloudy days	10	6	11	7	13
Number of cloudy days	14	14	13	16	9
Number of days on which rain fell	9	10	12	18	14
Number of days on which snow fell	2	1	1	..	..
Snow on ground at end of month, in.	..	..	..	..	..



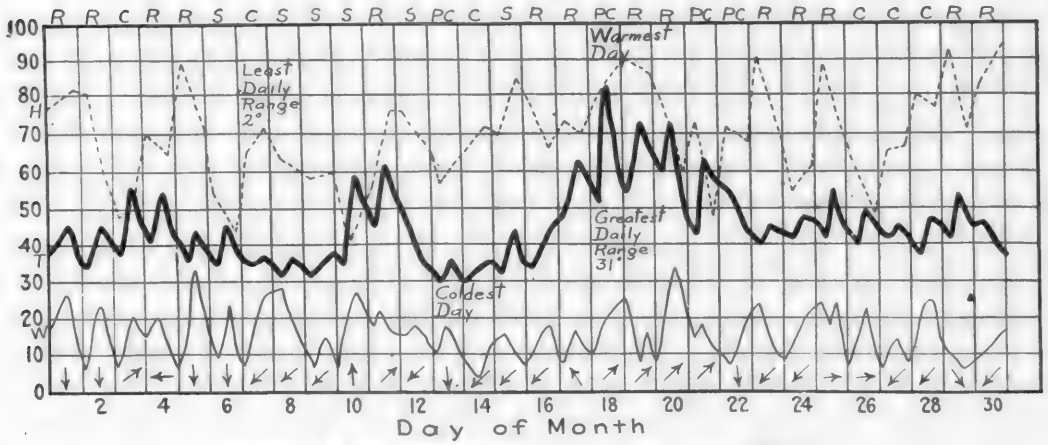
RECORD OF THE WEATHER IN NEW YORK FOR APRIL, 1917.
(Hourly Observations of the Relative Humidity are Recorded on this Chart.)



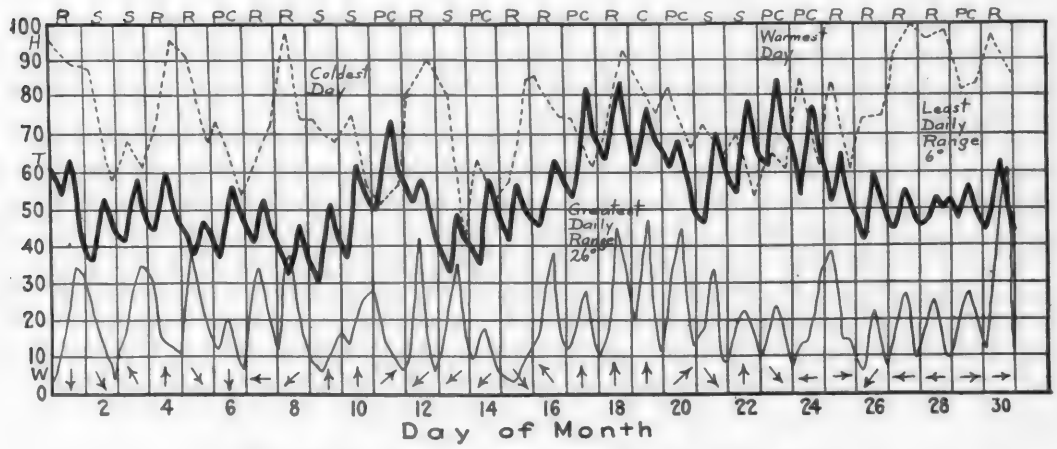
RECORD OF THE WEATHER IN BOSTON FOR APRIL, 1917.


C R S PC R R R Sn Sn S S PC C C C S PC R R PC R S R R R PC PC C C R
Coldest Day
Greatest Daily Range 34°
Least Daily Range 9°
Warmest Day
T H W
Day of Month

RECORD OF THE WEATHER IN PITTSBURGH FOR APRIL, 1917.


R R C R R S C S S S R S PC C S R R PC R R PC PC R R R C C C R R
Warmest Day
Least Daily Range 2°
Greatest Daily Range 31°
Coldest Day
H T W
Day of Month

RECORD OF THE WEATHER IN CHICAGO FOR APRIL, 1917.


R S S R R PC R R S S PC R S PC R R PC R C PC S S PC PC R R R R PC R
Coldest Day
Warmest Day
Least Daily Range 6°
Greatest Daily Range 26°
H T W
Day of Month

RECORD OF THE WEATHER IN ST. LOUIS FOR APRIL, 1917.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.

Heavy lines indicate temperature in degrees F.

Light lines indicate wind in miles per hour.

Broken lines indicate relative humidity in percentage from readings taken at 8 A. M. and 8 P. M.

S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.

Arrows fly with prevailing direction of wind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Summer Meeting To Take Up War Problems.

Engineering problems pertaining to the the heating and ventilating of army buildings and the drying of foodstuffs will have a prominent place in the programme for the forthcoming summer meeting of The American Society of Heating and Ventilating Engineers, in Chicago, July 18-20. Already, in response to a request from the Government, President J. I. Lyle has appointed a committee, consisting of W. S. Timmis, W. H. Driscoll, W. H. Carrier, Dr. E. V. Hill and F. R. Still, to confer with Government departments on plans for utilizing the services of the heating profession.

One of the principal problems that will have to be met is in connection with the drying of vegetables and fruit, as all signs point to a scarcity of the tin can supply. According to methods already in successful operation abroad food thus dried may be packed in cartons and kept in good condition without losing its food value. Other problems will have to do with the equipment of camps and military hospitals.

At a meeting of the society's Boiler Testing Code Committee, held May 18, a revised report was drawn up for a standard code and it is stated that the report will be presented in shape for final adoption at the next annual meeting of the society.

New Year Book for Heating Engineers' Society.

The 1917 year book of The American Society of Heating and Ventilating Engineers has been issued, showing a total membership of 775. This is by far the largest number of members the society has ever had on its rolls. The list of members is arranged alphabetically and geographically, and there are also lists of officers and committees, chapters and local secretaries, charter and constitution, and past officers and calendar of past meetings, the whole making a booklet of 116 pages. The increase in membership for the year is 70 and Secretary C. W. Obert reports that 62 additional applications for membership were received after the year book was issued.

New York Chapter Discusses Military Matters.

Plans for the arrangement and equipment of military camps, such as Camp Whitman, in New York State, were taken up at the closing meeting of the New York Chapter. The principal speaker on this subject was Captain Weston E. Fuller, of the New York National Guard. He said that there would be 32 camps similar to Camp Whitman located in different parts of the country and that the problems of heating, ventilation, water supply, and drainage would all have to be decided upon shortly and carried out by civilian boards. So far practically no plans have been made for heating or ventilating barracks or portable hospitals.

The meeting opened with the installation of the new president, Frank K. Chew, and the other officers. The meeting was then turned over to the chairman of the evening, George W. Martin, who called upon President Lyle of the society to tell of the steps the society had already taken to co-operate with the Government. At a meeting that morning, at which a committee of the society conferred with President Byron T. Gifford and Secretary D. L. Gaskill of the National District Heating Association, suggestions were made as to how the two organizations could supplement each other's efforts, both for Government service and in the advancement of their ordinary interests as well. These suggestions included one for a joint meeting of the two societies.

President Gifford and Secretary Gaskill, both of whom were present at the dinner, were called upon to address the meeting. Mr. Gifford said that the success or failure of a central heating plant is largely an engineering problem and he bespoke the interest of the heating engineers in the work of the National District Heating Association. Secretary Gaskill had something to say about the part the West is prepared to play in the war, declaring that there need be no fear that the West will do its full part and will raise the necessary food to supply not only the people of the United States, but the Allies as well.

The concluding speaker was Past President Reginald Pelham Bolton who presented his well-known lecture, illustrated with lantern slides, on "Revolutionary Relics on Manhattan Island."

Annual Banquet of Michigan Chapter.

The Michigan Chapter held its annual dinner at the Fellowcraft Club, Detroit, with a large attendance of members and guests. William F. McDonald acted as toastmaster and introduced the various speakers. Prof. John R. Allen spoke on "The Engineer at School." He was followed by J. R. McColl, whose subject was "The Consulting Engineer"; by Charles A. Blaney, who spoke on "The Heating Engineer"; and by Fred R. Still, whose topic was "The Sales Engineer." The speaking was interspersed with music. James E. Degan, as chairman of the entertainment committee, successfully carried out the arrangements for the dinner. The menus contained, in addition to a list of the speakers and officers, a complete list of the chapter's members, showing a total of 99.

The May meeting of the chapter was held at the University of Michigan, Ann Arbor, May 26. The trip from Detroit was made by automobile, a stop being made at Westwood where a frog and chicken dinner was served. Arriving at the university the party was taken to the Engineering Building where Professor John R. Allen, who had charge of the meeting, and other members of the engineering staff addressed the chapter.

Illinois Chapter Holds Dinner Dance.

The Illinois Chapter wound up its season with a dinner dance at the Hamilton Club, Chicago, May 17. Following a lecture on the European war by Dr. Preston Bradley, dancing was indulged in to the music of Henschell's orchestra, the ladies being well represented.

Automatic Heat Control Discussed by Eastern Pennsylvania Chapter.

"Automatic Control as Applied to Heat Regulation," was the principal topic for discussion at the May meeting of the Eastern Pennsylvania Chapter, held at the Engineers' Club, Philadelphia, May 10. S. E. Plewes presented the subject and exhibited models of improved present-day devices, illustrating the great advances made in recent years. Mr. Plewes attributed the "positive reliability" of modern automatic control, as distinguished from manual control, to the highly-developed design and special materials now used in the manufacture of temperature-regulating devices.

Among those present was John F. Hale who has returned to Philadelphia from Chicago, having recently been elected vice-president of the Braemer Air Conditioning Corporation, of Philadelphia, Mr. Hale will transfer his activities from the Illinois to the Eastern Pennsylvania Chapter.

The May meeting was the last for the season, the next regular meeting being scheduled for October 11.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Master Steam Fitters' Convention Postponed.

At a meeting of the board of directors of the National Association of Master Steam and Hot Water Fitters, held May 17, it was voted to temporarily postpone the convention of the association, which was to have been held in Chicago, June 11-14, with headquarters at the Hotel Sherman. This action was taken "on account of the uncertain conditions brought about by our country being in a state of war."

New York State Association.

Officers were elected as follows at the annual convention of the New York State Association of Master Steam and Hot Water Fitters, held in Albany, May 8: President, John R. Sheehan, Schenectady; vice-president, H. J. Brandeles, Utica; secretary-treasurer, W. J. Olvany, New York; corresponding secretary, Henry B. Gombers, New York; sergeant-at-arms, W. T. Cantwell, Utica. The new directors are: C. Ashmunsen, Albany; W. F. Devendorf, Rochester; John J. Doherty, Poughkeepsie; W. T. Lane, Buffalo and E. F. Joy, Syracuse. A dinner at the Hotel Hampton followed the close of the convention.

Deaths.

S. Louis Barnes, former president of the National Association of Master Plumbers, died at his home in Germantown, Philadelphia, May 9, from cerebro-spinal meningitis. Mr. Barnes was 48 years old and had been in good health up to the time of his last illness which began April 18. Mr. Barnes was president of the national master plumbers' association at the time when it was under the most extensive government prosecution and became well-known for his efforts in maintaining the integrity of the organization.

National Pipe and Supplies Association Holds Annual Convention.

A record attendance of 450 members and guests, made up almost entirely of manufacturers and jobbers, was registered the annual convention of the National Pipe and Supplies Association which was held in Philadelphia, May 9, at the Bellevue-Stratford Hotel.

One of the principal addresses was made by James Francis Burke, general counsel for the Pittsburgh Chamber of Commerce, who spoke in a patriotic vein. A symposium on the trade outlook brought out the fact that prices were high and materials hard to obtain, so that a further rise in prices is to be expected. J. J. Kennedy, sales manager for the National Tube Company, reported a shortage in pipe due to the requirements and export trade, as well as to the shrinkage in production for lack of sufficient labor. W. E. Manning, sales manager of the Youngstown Sheet & Tube Company, expected the tendency toward slow deliveries would prevail for some time. John Duncan, sales manager of the Wheeling Steel & Iron Company, expected an advance and called attention to the comparatively small advance up to date in the cost of pipe. J. F. Conran, sales manager of the Standard Sanitary Mfg. Co., gave an encouraging report and stated that a great many buildings were being rebuilt which was offsetting to a degree the let-up in new building work. L. M. Johnson, general manager of the A. M. Byers Co., referred to the rapidly-increasing cost of raw materials, making the immediately future an uncertain quantity.

COST OF DOING BUSINENSS.

The association's recent investigation on the cost of doing business in 1916 showed that 73 replies had been received. Of these, 49 showed the following averages: Gross profit, 26.13%; cost 18.08%; net profit, 8.05%. These reports included interest charges on both borrowed money and capital. Sixty-three reports, which did not include the interest items, showed the following averages: Gross profit, 25.8%; cost, 15.55%; net profit, 10.25%.

Reports on the volume of business done so far this year showed that the volume was 39.83% greater in value, but about the same in tonnage.

NEW OFFICERS.

The new officers elected are:

President, L. C. Huesmann, Central Supply Co., Indianapolis; first vice-president, George V. Denny, Georgia Supply Co., Savannah, Ga.; second vice-president, R. S. Woodruff, C. S. Mersick & Co., New Haven, Conn.; secretary-treasurer, Geo. D. McIlvaine, Pittsburgh.

Executive Committee: I. F. Young, Young & Vann Supply Co., Birmingham, Ala.; W. E. Clow, Jr., Jas. B. Clow & Sons, Chicago; F. N. Sheldon, Braman, Dow & Co., Boston; John S. Simmons, John Simmons Co., New York City; J. B. Rahm, U. S. Supply Co., Omaha, Neb.; Geo. B. Limbert, Geo. B. Limbert & Co., Chicago; C. J. Clark, of the Hunter & Dixon Co., Philadelphia.

Advisory Board: W. M. Pattison, W. M. Pattison Supply Co., Cleveland; A. E. Ford, Ford & Kendig Co., Philadelphia; Alex. B. Pierce, N. O. Nelson Mfg. Co., St. Louis, Mo.

NATIONAL DISTRICT HEATING ASSOCIATION

Committee Named to Co-operate with Government.

President Byron T. Gifford has appointed the following committee to confer with Government authorities regarding the heating of groups of buildings used for military service: Davis S. Boyden, Boston; Charles R. Bishop, North Tonawanda; and George W. Martin, New York.

Building Operations for April.

A decrease of 8% in the total of building operations for April, 1917, as compared with the same period in 1916, is shown in the reports from 115 cities, as compiled by the *American Contractor*, Chicago. The total was $86,100,925 as compared with $94,029,102 in April, 1916. Considering the possible effects of the war declaration, the loss of but 8% for April is looked upon as a remarkably good showing.

Among the cities reporting gains are: Akron 81%; Atlantic City 472%; Boston 17%; Detroit 38%; Erie 144%; Hartford 10%; Los Angeles 115%; Milwaukee 131%; Newark 38%; St. Louis 70%; and Worcester, Mass., 76%. Important cities showing losses were: Chicago 16%; Cincinnati 10%; Cleveland 7%; Minneapolis 58%; New York City 40%; Philadelphia 19%; Pittsburgh 12%; Rochester 52%; San Francisco 60%; Washington. D. C., 40%.

VENTILATION.

Number of Air Changes.

The table below shows the changes of air per hour, or the cubic feet per minute (C.F.M.) per occupant, recommended for various rooms in hospitals, sanitariums, private hospitals in other buildings, and similar apartments used for medical purposes.

HOSPITALS

ROOM	SUPPLY		EXHAUST	
	C.F.M. Per Occupant.	Minimum Air Changes Per Hour.	C.F.M. Per Occupant.	Minimum Air Changes Per Hour.
Anesthesia	..	8 (with local control)	..	12
Autopsy	..	4	..	8 to 10
Bakery	..	none	..	10
Baths, Toilets, etc.	..	none	..	12
Boiler (large)	..	10	..	none
Clothes Storage	..	none	..	6
Dairy, Meats, etc.	..	none	..	8
Dark	..	4	..	6
Delivery	60	8	60	8
Dining	20	6	30	8
Doctors Wash	..	none	..	o
Dressing	..	none	..	6
Drying Closets	..	none	..	20
Electrotherapeutic	..	6	..	8
Engine	..	4 to 6	..	8 to 10
Examination	..	6	..	6
Gymnasium	30	8	30	8
Hydrotherapeutic	..	6	..	8
Ice Making	..	none	..	4 to 6
Instrument (Prep.)	..	none	..	6
Isolation	30 to 60	6	30 to 60	6
Kitchens	..	6 to 8	..	15
Laboraties	..	6	..	8 to 10
Laundry (Small)	..	none	..	10
Laundry (Large)	..	6 to 8	..	12
Lockers	..	none	..	6 to 10
Machinery	..	4 to 6	..	8 to 10
Marking and Sewing	..	none	..	6
Meats, Dairy, etc.	100	none	100	8
Operating	..	10	..	10 (See Note A)
Pantries (Serving)	..	none	..	12
Plaster	..	4	..	6
Preparation (Inst.)	..	none	..	6
Pus Dressing	..	5	..	8
Pump and Refrigeration	..	4 to 6	..	8 to 10
Recovery	..	8	..	8
Refrigeration and Pump	..	4 to 6	..	8 to 10
Serving Pantries	..	none	..	12
Sewing and Marking	..	none	..	6
Shops, etc.	..	none	..	6
Solarium	..	4	..	4
Slop Sink Closets	..	none	..	12
Sterilizing Room	..	8	..	12
Stores	..	none	..	4
Toilets, Baths, etc.	..	..	..	12
Utility	..	none	..	12
Waiting	30	6	30	6
Wards (Gen'l)	30 to 60	6	30 to 60	6
Wards (Contagious)	100	10	100	10
Wash (Doctors)	..	none	..	8

Note A—Operating Rooms should have auxiliary top outlet in exhaust system.

VENTILATION.

Number of Air Changes.

The table below shows the changes of air per hour, or the cubic feet per minute (C.F.M.) per occupant, as recommended by the best authorities, for various rooms in hotels and their various service departments and in libraries.

HOTELS

ROOM	SUPPLY		EXHAUST	
	C.F.M. Per Occupant	Minimum Air Changes Per Hour	C.F.M. Per Occupant	Minimum Air Changes Per Hour
Ball Rooms	30	8	30	8
Banquet Hall	30	8	30	8
Bathroom (Private) ..	..	none	..	10
Boiler Room (Large)	..	10	..	none
Dining	30	8	30	8
Engine, Large	..	4 to 6	..	8 to 10
Kitchen	..	6 to 8	..	15
Laundry	..	6 to 8	..	12
Locker Room	..	none	..	10
Pump Room (Large) .	..	4 to 6	..	8 to 10
Sleeping	..	none	..	note—see note "A"
Toilets (Main)	..	none	..	12
Toilets (Private)	..	none	..	10
LIBRARIES				
Administration Center	..	6	..	6
Book Rooms	30	6	30	6
Galleries, Public	..	4	..	4
Galleries, Picture	..	4	..	4
Lecture Rooms	30	8	30	8
Locker Rooms	..	none	..	10
Lobbies—Large Bldgs.	..	8	..	none
Museums	..	4	..	4
Reading Rooms	30	6	30	6
Stack Room	..	none	..	4
Toilet Rooms	..	none	..	10

Note A—Sleeping rooms with connecting baths can be ventilated through the bath.

VENTILATION.

Number of Air Changes.

This table shows the changes of air per hour or the cubic feet (C.F.M.) per minute per occupant, as recommended by the best authorities, for various rooms in schools, institutes, colleges, universities, and other educational buildings.

SCHOOLS

ROOM	SUPPLY		EXHAUST	
	C.F.M. Per Occupant	Minimum Air Changes Per Hour	C.F.M. Per Occupant	Minimum Air Changes Per Hour
Auditorium	20 to 30	8	30	8
Board	..	6	..	6
Chemical Lab.	30	6	30	6
Chemical Cabinets	none	none	100 per cabinet	..
Class	30	6	30	6
Coat	none	none	..	8
Commercial	30	6	30	6
Corridors	..	See Note A	..	..
Domestic Science	30	6	40	8
Drawing	30	6	30	6
Dress Making	30	6	30	6
Forge Shop	See Note B	..	..	See Note B
Forges	200 c.f.m	per forge	400 c.f.m.	per forge
Gymnasium	30	8	30	8
Kitchen for Lunch Room	..	6 to 8	..	12
Kitchen for Cooking Class	30	6	50	10
Kitchen (Model)	..	6	..	8
Lecture	30	8	30	8
Library	30	7	30	7
Locker	none	none	..	10
Lunch	..	6	..	10
Machine Shop	30	6	30	6
Model Apart.	..	4 to 6	..	4 to 6
Office—General	..	6	..	6
Office—Private	none	none	none	none
Physical Lab.	30	6	30	6
Recitation	30	6	30	6
Shower Baths	none	none	..	10
Swimming Pool	..	4	..	10
Toilets	none	none	..	10 to 12
Wardrobes	none	none	..	8
Wood Working	30	6	40	8

Note A—Air supply to corridors should be 4 changes per hour or enough additional to be sufficient to counterbalance the excess of exhaust from all rooms connected to corridors where there is no air supply or where the supply is less than the exhaust.

Note B—The air supply to a forge room should be not less than 30 c.f.m. per occupant and should be increased to make up any unbalanced condition occurring when the forges are all running each being supplied with 200 c.f.m. air blast and 400 c.f.m. forge exhaust.

VENTILATION.

Number of Air Changes.

The table below shows the changes of air per hour, or the cubic feet per minute (C.F.M.) per occupant, as recommended by the best authorities for various rooms of miscellaneous character as listed below.

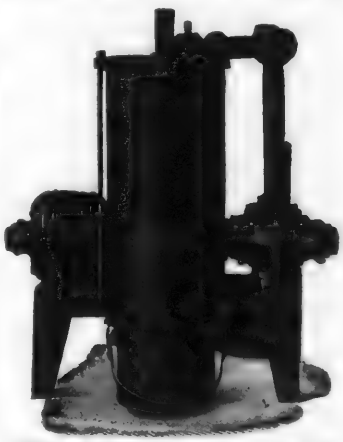
ROOM	SUPPLY		EXHAUST	
	C.F.M. Per Occupant	Minimum Air Changes Per Hour	C.F.M. Per Occupant	Minimum Air Changes Per Hour
Assembly and Conventi Halls	30	8	30	8
Boiler Rooms	..	10	..	none
Engine Rooms	..	4 to 6	..	8 to 10
Factories	20 to 30	4	20 to 30	4
Foundries	..	4	..	4
Halls and Assemblies	30	8	30	8
Mill Buildings	20 to 30	4	20 to 30	4
Offices (outside small)	none	..	none	..
Offices (inside small)	..	6	..	6
Offices (large)	20 to30	..	20 to 30	..
Private Office (large)	..	6	..	6
Private Office (small)	..	none	..	none
Public Offices (large)	..	4 to 8	..	4 to 8
Public Offices (inside small)	..	6	..	6
Public Offices (outside small)	..	none	..	none
Public Toilet Rooms	..	none	..	10
Public Waiting Rooms	..	4 to 6	..	4 to 6
Pump Rooms	..	4 to 6	..	8 to 10
Round Houses	..	none	..	12
Toilets	..	4 to 6	..	10
Waiting Rooms	none	..	..	4 to 6

Vacuum cleaning for apartments and residences

It is general practice for the trade to specify for vacuum cleaning in buildings of appreciable size, just as he specifies for heating requirements.

These 26 apartments, equipped with an ARCO WAND Vacuum Cleaner. Owner says machine after two years' use gives perfect satisfaction. Used with equal success in hundreds of apartment buildings.

ARCO WAND VACUUM CLEANER may be specified for small or large buildings of any kind. Made in one or two sweeper capacity and with tool equipment to fill any need. The ARCO WAND has given universal satisfaction and has never failed the test of continuous daily service.



ARCO WAND Single Sweeper Machine also made as two sweeper and mounted on truck

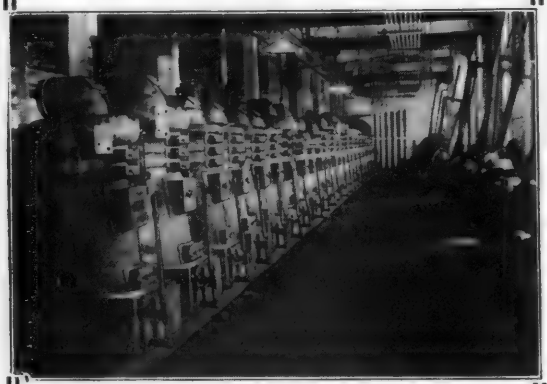
We are pleased to give the trade all possible help by furnishing vacuum cleaning data and full information.

The ARCO WAND may be seen in operation in any of our showrooms.

AMERICAN RADIATOR COMPANY

Sales branches and showrooms in all the large cities

Now It's Ready



Portion of Mounting Floor
Showing the production of the new

INTERNATIONAL ECONOMY ROUND BOILERS

Two years of experimenting, testing and proving each step explain why we call this new line

ECONOMY

A modern boiler of high efficiency, made in 15 sizes for steam, and corresponding sizes for hot water.

Send your name and address for catalog 269-A which tells the complete story.

INTERNATIONAL HEATER CO.
The Prompt Shippers
UTICA, N. Y.

CHICAGO
1933 Wentworth Ave.

NEW YORK
601 West 27th St.

ADVERTISERS' INDEX

Air Moistener Co., The..... 77
Alberger Pump & Condenser Co..... 12
Alberger Heater Co..... 64
American District Steam Co..... 78
American Blower Co..... 71
American Radiator Co..... 59

Bayley Mfg. Co. 4
Bicalky Fan Co..... 14
Braemer Air Conditioning Corporation.. 9
Bristol Co., The.....Front Cover
Buffalo Forge Co..... 7

Carrier Engineering Corporation..... 70
Central Station Steam Co..... 74
Clarage Fan Co.....Second Cover
Connersville Blower Co..... 3

Davis Regulator Co., G. M..... 82
Detroit Lubricator Co..... 65
Dole Valve Co.....Front Cover
Dunham Co., C. A..... 14

Economy Pump Machinery Co..... 77
Foster Engineering Co. 75
Fulton Co., The..... 11

Gurney Heater Mfg. Co.....Front Cover

Hornung, J. C..... 75
Howard & Morse..... 61

Ilg Electric Ventilating Co..... 66
International Heater Co..... 60

Jenkins Bros..... 63
Johns-Manville Co., H. W..... 69
Johnson Service Co..... 68

Kewanee Boiler Co.....Fourth Cover
Knowles Mushroom Ventilator Co., Front Cover

Lavigne Mfg. Co..... 8

Marsh Co., Jas. P..... 3
Mason Regulator Co. .....Front Cover
McAlear Mfg. Co..... 12
Mueller Mfg. Co., H. 5

National Air Cell Covering Co..... 79
National Tube Co..... 6

Ohio Blower Co..... 74

Parker Supply Co. 4
Patterson & Co., Frank..... 73
Powers Regulator Co..... 79

Ric-Wil Co..... 78
Ross Valve Mfg. Co.....Front Cover

Sarco Company, Inc..... 73
Sims Co., The..... 82
Standard Thermometer Co..... 63
Standard Wood Pipe Co. 78
Sturtevant Co., B. F.....67, 74 and 77

Taylor Instrument Companies..... 72

United Vacuum Appliance Co..... 70

Webster & Co., Warren..... 62
Westinghouse Electric & Mfg. Co..... 10
Wyckoff & Son Co., A..... 81

TRADE AND MISCELLANEOUS NOTES

Coming Events.

June 19-21, 1917.—Thirty-fifth annual meeting of the National Association of Master Plumbers, at Evansville, Ind. Headquarters at the new Hotel McCurdy.

July 18-20, 1917.—Summer meeting of The American Society of Heating and Ventilating Engineers, in Chicago, Ill. Headquarters at the Hotel La Salle.

Miscellaneous Notes.

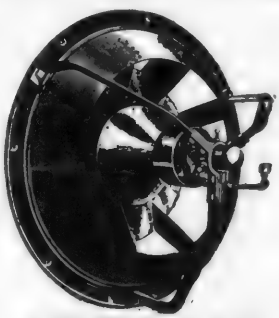
A. M. Feldman, New York, consulting engineer, announces the removal of his offices to 19 West 44th Street, telephone Vanderbilt 6226.

Davenport, Ia.—A proposed amendment to the building code dealing with the inspection of boilers would require semi-annual inspection of all boilers in the city carrying over 10 lbs. of steam pressure to the square inch. It was agreed that the inspection made by the representatives of insurance companies would be accepted by the building commissioner.

Clinton, Ia.—That work on the new Northwestern passenger station in Clinton will be under way before the close of 1917 is the prediction of W. H. Finley, chief engineer of the Chicago and Northwestern Railway. It is probable that the heating of the various buildings, including the new freight house and the new passenger station, will be done from one central heating plant.

Detroit, Mich.—Work is progressing on the compilation of the new building code for Detroit. Manufacturers of warm air furnaces and heating appliances were given a hearing April 27 before the building code revision committee when the heating sections of the code came up for consideration.

Columbus Heating & Ventilating Co., Columbus, O., has inaugurated a potato-growing contest for its employees, with prizes



DUPLEX CONE FAN
Belt Driven

HOWARD & MORSE
45 FULTON ST., N. Y.
Ventilating Engineers and Contractors
MANUFACTURERS OF
BLACKMAN and DUPLEX CONE FANS
which are installed by us complete with **Motors, Duct Work** and **Wiring.**

Aligning, Rigging and **Hoisting** done, with labor thoroughly qualified from long experience.

We make a specialty of **Kitchen Exhaust** work. Prominent buildings, hospitals, theatres, and private residences are among our many and recent installations.

The **Duplex Cone** Fans are semi-conoidal fans, made especially to operate against pressure in duct systems.

The **Blackman** Fans are used for fresh air delivery and in duct systems, when no great pressure is involved.

You can have the advantage of our experience.

SEND FOR CATALOGUE

BLACKMAN FAN
Direct Connected to Motor

of $25, $15 and $10 for the employees who raise the most potatoes between June 1 and October 20 on a patch containing 1,500 sq. ft.

Detroit, Mich.—Resolutions were adopted by the Detroit Society for the Study and Prevention of Tuberculosis, at a recent meeting, calling the attention of the Board of Education to "the poor ventilation in many of the city schools." City and inter-urban street cars were also cited as requiring better ventilation. David E. Heinemann, vice-president of the society, stated that he would urge the passage of an ordinance requiring all inter-urban cars to be thoroughly aired during the trip around the Jefferson and Griswold Streets loop.

Newark, N. J.—Enlargements of the heating plants of the Overbrook Hospital and the penitentiary have been recommended by the building committee of the Board of Freeholders. The additions to the penitentiary plant will cost about $70,000. At the Overbrook Hospital the entire heating system will be remodeled. Frederick O. Runyon, of Runyon & Carey, is the consulting engineers.

Ludington, Mich.—"Standard" plates have been placed by State officials on two schools in Pere Marquette township and one in Summit township, signifying that those schools have met the requirements of the department in regard to ventilating, lighting and general sanitary equipment. Mason County now has 21 "standardized" schools, and leads the State in percentage.

Automobile users are being initiated into the mysteries of heat transmission by the technical bulletins issued by one manufacturer, calling attention to the importance of keeping the radiator cells free from foreign matter, particularly when driving over muddy roads or on dusty highways. If the trip is at all long, the accumulation of dust, dirt and mud pellets, driven to a lodging place by the motion of the car, seriously impair the radiation by retaining the heat which the radiator core would ordinarily dissipate in the air. An examination of only a limited number of motor cars will reveal radiator interstices that are so tightly packed with particles of earth that they can play no part in reducing the temperature of the water system.

PREPAREDNESS: An installation of the Webster System NOW, will surely guard you against any Heating Troubles

The WEBSTER Vacuum System of Steam Heating is a method of circulating exhaust steam, live steam, or a combination of the two, to obtain not only the utmost efficiency, but the greatest economy.

The manufacturer who is now wasting exhaust steam, which might be put to profitable use in heating, is actually throwing money away, since all exhaust steam not so utilized requires additional live steam to be generated, at the expense of fuel and labor, and the extra wear on the power plant to do the work.

Webster **VACUUM SYSTEM OF STEAM HEATING**

has been installed in over 10,000 buildings during the past 29 years. This record has been achieved only by giving uniformly successful results.

The WEBSTER System is adapted to the heating problems of the manufacturer, whether his factory is housed in a single building or in an extended group of buildings.

Old buildings can be "Websterized," very often at comparatively little expense.

The WEBSTER System overcomes excessive coal bills, nerve-racking "water-hammering," odor, noise, etc. Circulation of the steam is secured with little or no back pressure. The Webster Modulation Valves control the temperature in each room.

Let us explain to you how the WEBSTER System will prove a most thoroughly reliable, efficient and economical heating system.

Write us today. Ask for Catalogue V-37

WARREN WEBSTER & COMPANY

Manufacturers of Webster Systems of Steam Heating, Webster Feed Water Heaters, Webster-Lea Heater-Meters, Webster Steam and Oil Separators, Webster Steam Specialties

MAIN OFFICE AND WORKS **CAMDEN, NEW JERSEY** POINT AND PEARL STS

ESTABLISHED 1888 BRANCH OFFICES IN PRINCIPAL CITIES

Market Conditions are the subject of a thoughtful letter written by C. V. Kellogg to *Domestic Engineering* and published by that journal. "It is my opinion," says Mr. Kellogg, "that prices will be no lower during 1917. On the contrary, they will be much higher, and it is important that the plumbing and heating trades protect themselves immediately for material necessary to install any contract, which they have, and to order same shipped as early as possible for self-protection. I base this opinion upon the following facts:

"Pig iron has advanced approximately 200%. That is, it is three times as high today as it was in 1915. Copper is the same and all raw materials, which enter into manufactured goods, are approximately three times the cost of 1915. Labor has advanced at least 50%. Production of plants has decreased to about 60 to 65% of the capacity of the plant, and yet finished goods such as enameled ware, radiation, boilers, plumbing material, have only advanced about 100%. Many articles only advanced 85% of low price, so that if the manufacturer and distributor is basing his present selling prices on cost of replacement of raw material, goods are selling too low.

"Another reason is that the cost of doing business has advanced. That is, the present cost of doing business has increased at least 25%. If a plumber or steam fitter figured that his cost of doing business was 20%, he should add at least 25% of the 20% and make it 25%.

"The government is entering the market for the purchase of raw material or goods manufactured from raw materials, which are needed for the lines which the plumber and steam fitter uses. The railroads are short of equipment. Today there is a shortage of cars, and much delay in the shipment of material, and as soon as the railroads are obliged to move the crops, they will be unable to handle material for the government and material for the ordinary consumption. The handling of crops and government material will be given the preference, and when the busy season arrives for the steam fitter, and his customer desires the goods, he will be unable to get them because of inability of railroads to make delivery.

"The railroads also will be in the market to buy. All of these conditions are going to tend to advance the present prices, and yet the market is in such condition that I do not recommend for a plumber or steam fitter to stock up, because none of us know when the war may end, although I do not look for any immediate cessation. When it does happen the loss of goods in stock by the plumber or steam fitter, which he does not need, will more than offset any profit he may have made by stocking up.

"My advice, however, is that the trade should immediately protect themselves and should have the goods shipped as speedily

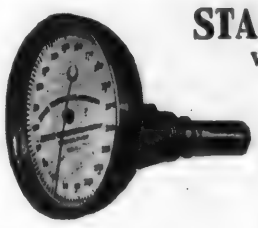
Jenkins Bros. Valves

There is never any question with the user about the quality of Jenkins Bros. Valves—the "Diamond Brand." They are time-tested and performance-proved. They are made of high grade steam metal, and capable of withstanding not only all average working pressures, but have an ample factor of safety besides.

There's a Jenkins Bros. Valve for practically every purpose. Let us figure on your requirements.

Jenkins Bros.

New York Boston Philadelphia Chicago Montreal London



STANDARD THERMOMETERS - Indicating and Recording

VACUUM, STEAM and HOT WATER SYSTEMS, BAKE OVENS and COLD STORAGE PLANTS. SEVEN models of RECORDING and EIGHT of INDICATING Thermometers. All Accurate, Durable and Legible.

Backed by thirty years of Thermometer manufacturing.

They are practically indestructible, are sensitive to changing temperatures and are very easily installed. Supplied with horizontal or vertical extension and standard pipe thread.

Ask for catalog No. 100-107 and trade prices.

STANDARD THERMOMETER COMPANY, 65 Shirley St., Boston, Mass.

Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

as possible, so as not to be caught short when they need the goods."

R. T. Crane, Jr., president of Crane Co., Chicago, was the host of Marshal Joffre, René Viviani, Admiral Cocheprat and other members of the French Mission to the United States, during the mission's stay in Chicago. A reception in their honor was given at Mr. Crane's residence May 4.

Range Boiler Exchange, through Secretary A. A. Ainsworth, of New York, has announced its adoption of the following sizes of expansion tanks, as standard:

Size, in Inches.	Approximate Gallons Capacity,
10 × 20	8
12 × 20	10
12 × 30	15
14 × 30	20
14 × 36	24
16 × 30	26
16 × 36	32
16 × 48	42
18 × 60	66
20 × 60	82
22 × 60	100
24 × 60	120

The following sizes are not included in this new standard list and will not be made in the future: 9 × 20 in., 5½ gal.; 12 × 24 in., 12 gal., and 12 × 36 in., 18 gal.

Engineers' Society of Western Pennsylvania, in Pittsburgh, Pa., has moved into its new quarters, Rooms 565-569, Union Arcade Building, Fifth Avenue and William Penn Way.

Washington, D. C.—The executive committee of the Chamber of Commerce of the United States, has arranged to hold continuous sessions in Washington for the time being to consider the programme of the national chamber in the war and to confer with various government officials to ascertain exactly how the business men of the country may be of the most assistance at this time.

World's Salesmanship Congress held its 1917 sessions in Detroit, Mich., June 10-14. A special departmental session was given up to "Salesmanship in the Building Field."

Central Station Heating Notes.

Spencer, Ia.—An organization has been formed in Spencer to further the movement for the establishment of a central station heating system in that place. The officers

Dangerous Strains are Eliminated

IN THE

Alberger Multi-Head Water Heater

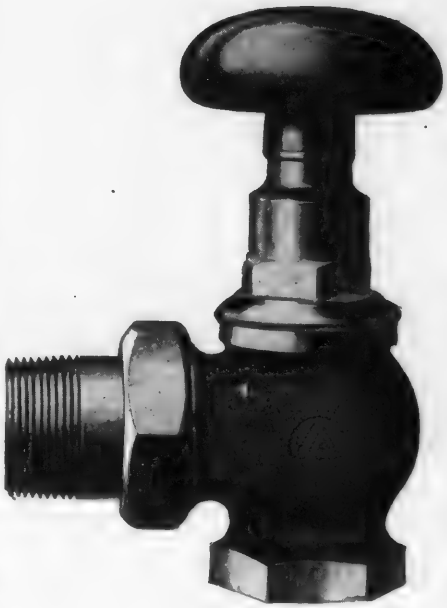
"The Heater without the Usual Heater Troubles"

Note the series of "floating" tube heads into which the tubes are expanded at one end of the heater. With this arrangement the several groups of tubes can expand or contract, entirely independent of each other, thereby accommodating the expansion.

ALBERGER HEATER CO., Buffalo, N. Y.

Western Office: Peoples Gas Bldg., Chicago — Agents in all principal cities

DETROIT PACKLESS RADIATOR VALVES



The Correct Valve for the Beautiful Home

Detroit Packless Valves are finished with the definite purpose, that they shall harmonize with the most beautiful surroundings. In addition to their unusually pleasing appearance and smooth satin finish they are permanently efficient and will not leak or need repacking.

Booklet VP-1 Gladly Sent Upon Request

DETROIT LUBRICATOR COMPANY

DETROIT, U. S. A.

CANADIAN DETROIT LUBRICATOR COMPANY, LTD. WALKERVILLE, ONTARIO.

LARGEST MANUFACTURERS OF RADIATOR VALVES IN THE WORLD

are: President, J. H. McCord; secretary, A. Maurer; treasurer, J. E. Knudson; directors: J. H. McCord, C. P. Buckey, A. Maurer, J. E. Knudson and Robert Hanson. The plan is to sell stock and buy the steam from the city, making the charges sufficient to net a 7% return on the stock and to retire the stock in from five to seven years. The cost of the system is estimated at $35,000.

Manson, Ia.—Manson is considering the establishment of a municipal heating and lighting plant.

Ishpeming, Mich.—At a recent meeting of the Ishpeming Advancement Association, called by President William Leininger, the members were addressed on the subject of the proposed central station heating plant by W. K. Abernethy, manager of the Minneapolis branch of the Central Station Steam Company, of Detroit. To establish such a plant in Ishpeming, the cost would probably be $80,000. A non-by-product plant would be necessary, using high-pressure steam, as the local electric lighting plant is too far from the business district,

Showing Ilg Self-Cooled Motor Propeller Fan Exhausting Acid Vapor in a Tannery

I L G

Self-cooled Motor Propeller Fans

Are Ideal for Handling Smoke, Heat, Steam, Dust, Acid Vapors

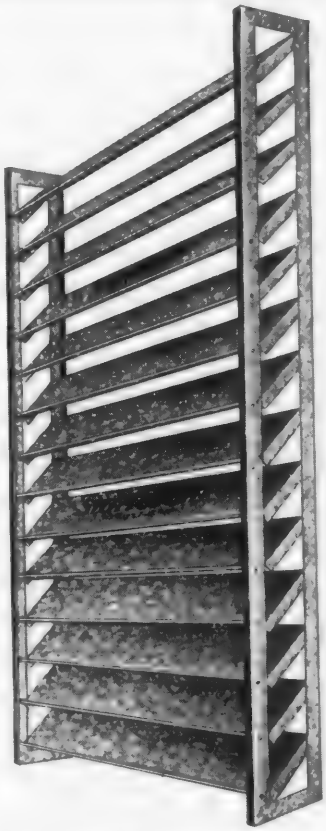
IN

INDUSTRIAL PLANTS

QUICK SHIPMENTS

I L G ELECTRIC VENTILATING CO.

158 Whiting St., Chicago



One Tier of Diffuser Plates

Diffuser Plates of

Sturtevant
(REG. U.S. PAT. OFF.)

AirWasher

The diffuser plates of the Sturtevant Air Washer prevent "back splash" and thus the atomized water is retained entirely within the Spray Chamber when the washer is in operation. Furthermore, these plates distribute the incoming air evenly and maintain a uniform velocity through the spray chamber.

These plates are a feature incorporated in the Sturtevant Air Washer only.

The other salient features of the Sturtevant Air Washer are:

Strainer area more than twice that of any other washer made and ten times the area of some.

Strainer designed for easy removal for cleaning. No bolts, clamps or latches to be manipulated or to give trouble.

More nozzles per thousand cubic feet of Air than any other washer.

Trap in overflow.

Supplies more water to eliminator plates for auxiliary washing than any other apparatus.

Send for copy of Catalog 226-V

B. F. STURTEVANT COMPANY

HYDE PARK, BOSTON, MASSACHUSETTS

And All Principal Cities of the World

Stationary Vacuum Cleaners, Air Washers, Fans, Heaters, Motors

even if the necessary arrangements could be made with the lighting company. Mr. Abertheny stated that 100,000 sq. ft. of radiation would give profitable operation, and recommended that the system be designed with a capacity of 200,000 sq. ft. He recommended that heat be sold on a meter basis at an average price of 60 cents per 1,000 lbs. of steam used. Further investigations made by the association developed the fact that the financing of the project would be the principal difficulty, as the banks would not be willing to advance more than 50% of the total cost.

Virginia, Minn.—Ten business blocks and more than 90% of the property owners on Chestnut Street have contracted to have their buildings heated by the new municipal heating plant which is being installed in Virginia. An addition is being built to the water and light plant to house the new boilers required which will include two of 500 H.P. each. Certificates of indebtedness in the sum of $110,000 will be issued by the city council to pay for the plant. It is estimated that the system will pay for itself in 15 years.

New Ulm, Minn.—At the annual meeting of the stockholders of the New Ulm Heating Company, two petitions, requesting the extension of the heating system, were read and approved, with the provision that the additions be made if the directors of the company find the plan feasible at this time. One petition covers an area on the west side of Minnesota Street, between Center and First South Streets, while the other petition is for an extension on both sides of Minnesota Street, between Second and Third North Streets. Superintendent A. J. Mueller of the city electric light and water station, stated that Charles Foster of the Chas. L. Pillsbury Co., of St. Paul, who drew the plans for the local system, and was the consulting engineer during the period of construction, would soon file a report favorable to the plan for the extension of the heating system to cover the areas in question. It was stated also that some live steam would necessarily be used during the coldest months of the winter, after the two extensions were hooked up, but that the revenue received during the month when no live steam would be required, would more than offset this item.

Luverne, Minn.—Luverne's central heating plant, to be fed with exhaust steam from the city power plant, will be installed this summer and, it is expected, will be ready for use by September 1. The contract for the construction of the plant has

Metal Sylphon Diaphragm Valves

ORIGINATED WITH THE

Johnson System of Temperature Regulation

The Pioneer System and Leader in Improvements

Untested imitations and substitutes followed fast. but, having been thoroughly tested and proved equal to the demands,

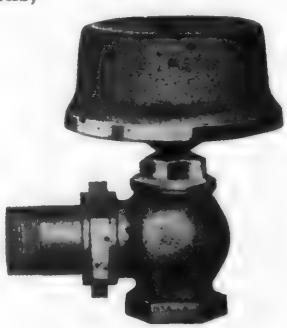
The SYLPHON is the Recognized Standard

It costs no more to install the JOHNSON SYSTEM than inferior products, so why assume the risks?

Communicate with our nearest branch in regard to your temperature regulation requirements.

Our co-operation is yours for the asking.

You can reach us overnight



The indestructible sylphon metal diaphragm valve

THE JOHNSON SERVICE COMPANY

New York **Chicago** **Boston** **Kansas City** **San Francisco**

been awarded to Bain & Robb, of Minneapolis and Milwaukee, contracting engineers, and work on the plant will start immediately. The contract price for the completed job is $37,000. The letting of the contract followed the completion of the organization of the City Heating Company of Luverne. The territory to be covered by the system is on Main Street from the power house to a point about 100 ft. east of Estey Street, a distance of approximately six blocks and on Cedar and McKenzie Streets. All subscribers of stock in the company will pay for heat used by them on the basis of 60 cents per 1000 lbs. of condensation. The money thus received will be applied to paying off the bonds and the stock certfiicates of the company, totaling some $20,000. When these are retired the plant will automatically become the property of the city. It is estimated that the plant will pay for itself in from 10 to 12 years. Dr. C. L. Sherman is president of the City Heating Company and J. E. Treat, secretary. In an item in the March issue regarding this project it was stated that Mr. Larsen was the St. Paul representative of the Mllwaukee Conduit & Insulation Company. This was an error, as L. A. Larsen, the well-known district heating engineer, of St. Paul, and the Milwaukee company are not connected in any way.

Richland, Wis.—A meeting of citizens was held recently in Richland to hear explanations and to discuss the feasibility of building a municipal heating plant to utilize the exhaust steam from the city electric light and water pumping plant. Professor Black, of the University of Wisconsin, presented the proposition and, after a statement by Mayor Smith, a committee was appointed to look further into the matter. This committee is composed of C. R. Thomson, Everett Pease and E. H. Edwards.

Seattle, Wash.—A serious situation arose in connection with the operation of the central station heating system of the Puget Sound Traction, Light & Power Company, when the city council held up the renewal of one of the company's heating franchise which had expired. The franchise committee of the city council turned in a report designed to prohibit the company from supplying steam heat to the business district which was covered by this franchise. The district in question lies between Madison and Main Streets and Third Avenue and the

Just a Ball—that's all

OFTEN it's the smallest fitting that kicks up the most trouble. Either it's hard to connect up, or the adjustment is delicate, or some little part keeps wearing out. And, on jobs where your margin is small, these little troubles play hob with profits.

So it will pay you to get acquainted with the Johns-Manville Radiator Valve—because it's the simplest on the market. Just three parts—body, ball, and connecting union; only one moving part—the hollow ball. It regulates itself—no nice adjustments, no chance of tampering. You'll find this valve a money-saver all along the line.

Pamphlet or prices on application.

H. W. JOHNS-MANVILLE CO.
NEW YORK CITY

10 Factories—
Branches in 55 Large Cities

JOHNS-MANVILLE

Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

waterfront, and takes in such buildings as the American Bank Building, Hoge, Alaska, New York, Transportation, L. C. Smith, Empire and Downs Crown Buildings. The deadlock arose over an effort by the city council to exact certain conditions from the Puget Sound company relating to the transfer of passengers on the company's trolley lines.

Manufacturers' Notes.

Industrial Service & Equipment Co., Boston, Mass., announces the removal of its offices to 226 Devonshire Street.

A. D. Granger Co., New York, dealers in power plant machinery and contractors for steam and electrical equipments, announces the removal of its offices to the Park Row Building, 15 Park Row.

Equitherm Control Corporation is the new name of the Geissinger Regulator Co., New York. The company's main office is 30 Church Street, New York, and its factory at 203 Greenwich Street.

American Radiator Company's employees have donated an ambulance to the American ambulance corps in France which is to be know as "The Frederick W. Monahan Memorial Ambulance." Mr. Monahan, who died March 19, was president of the Compagnie Nationale des Radiateurs, the French branch of the American Radiator Company. The machine will be driven by Emil H. Millet, of the company's Chicago office.

Richmond Radiator Co., New York, has announced a wage increase of 10%, which became effective May 1. The advance applies to about 500 employees at the company's plant in Uniontown, Pa.

Braemer Air Conditioning Corporation, Philadelphia, Pa., announces that John F. Hale has become identified with the corporation in an official capacity, with headquarters in the Lafayette Building, Philadelphia. The arrangement became effective May 1. Mr. Hale has been identified with the heating and ventilating business since 1893 and during the last 20 years has been with Warren Webster & Co., of Camden, N. J., as assistant general manager, and with the Consolidated Engineering Co., of Chicago, as vice-president and general manager. During this time, eleven years were spent with Warren Webster & Company and nine years with the Consolidated Engineering Company. Mr. Hale is a past

CONNERSVILLE VACUUM CLEANERS

Every architect and engineer should protect his client against law suits by insisting on the use of only licensed vacuum cleaners. "Connersville" machines are built for buildings of all sizes and for service of all sorts.

Simple - Efficient - Durable

United Vacuum Appliance Co.
Connersville, Ind.

Air Conditioning

never involves too complex a problem if you avail yourself of our advice

Carrier
Engineering Corporation
39 Cortlandt St., New York
Boston Philadelphia Buffalo Chicago

Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

Sirocco
TRADE MARK

Will Put Pure Washed Air Into Every Corner of Your Factory

The Dodge Bros. (Motor Cars) Office and Plant are almost exclusively equipped with Sirocco Products.

Their fine office building, here shown, is served by the Sirocco Washed Air System. Their Dining Room, Kitchen, Core Shop, Pressed Steel and Gear Shop have the healthful influence of a constant supply of fresh, properly tempered air. These departments, too, are served by Sirocco Apparatus.

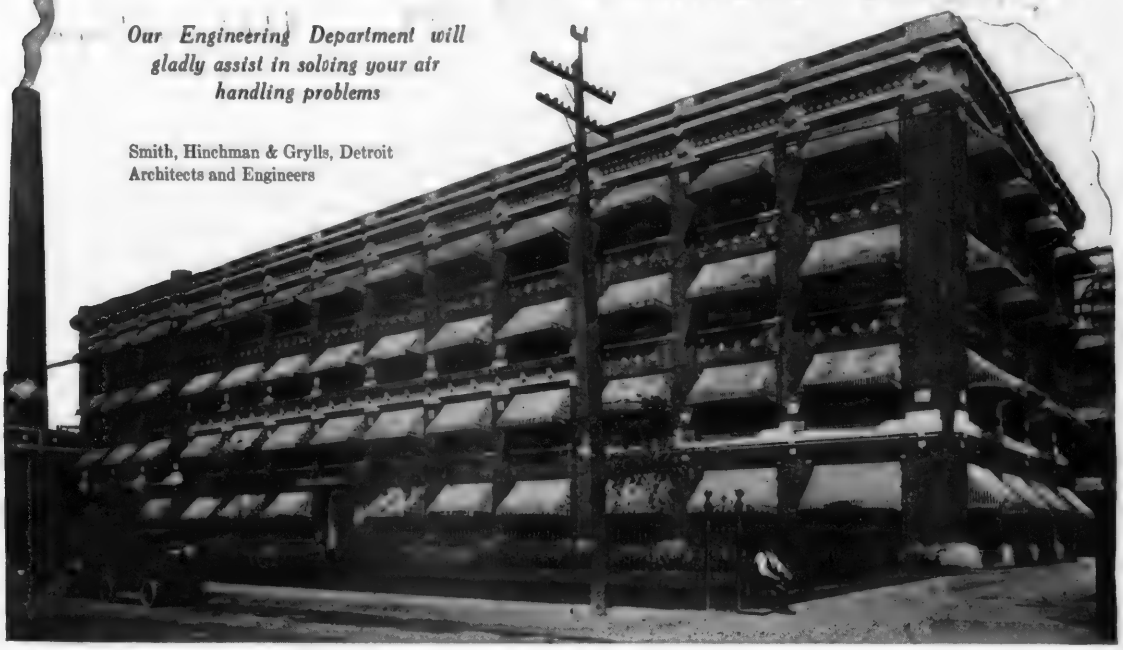
Book No. 2709 illustrates many plants in which "Sirocco" Systems are used. May we send it to you?

AMERICAN BLOWER CO.

DETROIT, MICH.

Our Engineering Department will gladly assist in solving your air handling problems

Smith, Hinchman & Grylls, Detroit
Architects and Engineers



Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

president of The American Society of Heating and Ventilating Engineers. During his years of association with Warren Webster & Company, he co-operated largely with Mr. Braemer in the company's air conditioning department, bringing him in close touch with this field. As announced last month, G. P. Upington has been appointed district manager of the corporation's New York district, with quarters at 90 West Street. Mr. Upington is a graduate engineer of the University of Kentucky and has had eleven years' experience in air conditioning work.

Central Foundry Co., New York, announces the election as its president of de Courcey Cleveland. Mr. Cleveland succeeds Waddill Catchings, who recently resigned as president of this company to become president of the Sloss-Sheffield Steel & Iron Company. Other changes in the officers of the Central Foundry are the election of Robert R. Rust as vice-president and general manager and of Fred D. Griffiths as secretary.

Sloan Valve Co., Chicago, announces the opening of branch offices in New York, Cleveland and San Francisco. The New York office is located in the Architects' Building, 101 Park Avenue, with J. F. Murphy in charge. The Cleveland office is in the Schofield Building, C. E. Sloan in charge. The San Francisco office is in the Wells Fargo Building, the manager being T. R. Burke.

Atlantic Radiator Co., Huntington, Pa., has moved its main offices to New York, the new headquarters being located at 359 West 42nd Street. The accounting and sales departments are now located in the New York quarters which contain also the offices of President Richard C. Schwoerer and of Vice-President Howard T. Gates, Assistant Secretary Alfred W. Smith will remain in charge of the company's plant in Huntingdon.

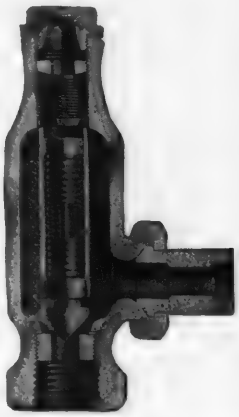
Utica Heater Co., Utica, N. Y., has arranged to insure the lives of its employees who have been in the service of the company six months or more. The insurance will be payable to the family or dependents of the insured in case of death from any cause while in the company's employ. The amount of the insurance runs from $500 to $1000, the latter figure being for those who have given 5½ years of service. This form of insurance, which went into

H&M
Tycos
Thermometers for every Purpose
thoroughly tested before it leaves our plant, and must remain so in actual service. The most exacting observance of details in production, methods, and the use of the finest equipment make possible the enviable reputation by which Tycos Instruments are known.
You may obtain a Tycos Thermometer with any desired temperature range. They are made in straight or angular styles with universally interchangeable separable sockets. We also make Recording Thermometers, Pyrometers, Hydrometers, Mercury Columns, etc.
In order that you may obtain truthful thermometer readings, know more about the reasons of Tycos superiority. Write today explaining your requirements.
The H&M Division
Correspondence invited. Our Catalogues should be in Your Possession.
There's a Tycos or Taylor Thermometer for Every Purpose

Radiator Trap
SARCO

Two Pipe Low Pressure - Vapor - Vacuum Heating Systems

Principle—Thermostatic
Motive Power—Liquid Expansion and Contraction



Positively noiseless in operation. No place for scale and dirt to lodge. Contact between head of valve and seat a line instead of surface. Distance inlet to outlet 1¾'' and can be installed at any angle. Guaranteed not to stick or air bind. You cannot buy a more accurate Radiator Trap no matter how much more you pay for it.

Send today for list and trial offer

SARCO COMPANY, Inc.

Chicago — Drexel Bldg., Philadelphia
New York — New Telegraph Bldg., Detroit

THE ⌐¬ SHAPE TUBES EXPLAIN THE SUCCESS of the

PATTERSON HOT WATER TANK

for heating water for domestic or manufacturing purposes. Both ends of each seamless brass tube are expanded into heavy cast-iron tube-heads with an improved roller expander. Their shape provides for the free contraction and expansion of each individual tube without straining, so there is no danger of leakage.

Type C. Patented Aug. 26, 1913.

Any Combination of Storage and Heating Capacities can be Furnished.
Send for Catalogue.

FRANK PATTERSON & CO., 26 Cortlandt Street, New York

Representatives in all Principal Cities.

Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

effect May 1, is distinct from the compensation insurance for accidents which continues without change.

New Incorporations.

Central Heating & Metal Co., Akron, O., capital $10,000. Incorporators: D. W. Alexander and others.

Soule Plumbing & Heating Co., Billings, Mont., capital $15,000. Incorporators: Candace Soule, Mary Soule and C. C. Tooker, all of Billings.

Keller Heating Co., Detroit, Mich., capital $5,000. Incorporators: W. F. Keller, Anna B. Keller and F. A. Hilton.

Charles H. Law Plumbing & Heating Co., Wilmington, Del., capital $25,000 to conduct a business as heating and plumbing contractors.

James Wilson Co., Hartford, Conn., incorporated to take over the heating and metal work business conducted under the same name.

F. B. Wheeler Co., Bridgeport, Conn., incorporated to conduct a heating, plumbing and tinning business.

New Firms and Business Changes.

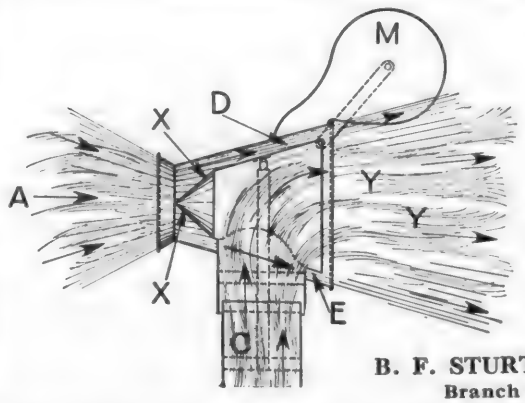
Henry A. Kries & Sons Co., Baltimore, Md., is the title of a new supply and contracting firm for heating and ventilating systems and power plants. Henry A. Kries, the head of the firm, has been in the heating business for forty years, 31 years with Crook, Horner & Company and nine years with Crook, Kries & Company. The company's quarters are at 6-8 West Lombard Street.

MANUFACTURERS OF
Equipment and Supplies
FOR
Central Station Heating Plants

Copper Diaphragm Expansion Joints, Slip Joints, Anchor Crosses, Line Anchors, Collars, Manhole-Curbs, Pipe Guides, and The Detroit Condensation Meter

THE DETROIT FEED WATER METER (another line)

Central Station Steam Co., Detroit, Mich.



Our Bulletin Gives Detail Installation Drawings

Our new bulletin which completely describes the

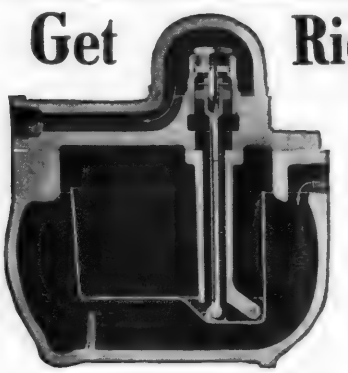
Sturtevant
(REG. U.S. PAT. OFF.)
Autoforce Ventilator

will be mailed promptly on request. It outlines the successful, scientific principle on which the Autoforce Ventilator works and shows why it displaces three times as much air as any ordinary stationary ventilator of same size, and twice as much as other ventilators of the swinging cowl type.

SPECIFY STURTEVANT AUTOFORCE

B. F. STURTEVANT CO., Hyde Park, Boston, Mass.
Branch Offices or Agents in all Principal Cities

Get Rid of Both Water and Trouble



with the

Swartwout Hydromatic Trap

No trouble because there is nothing to get out of order. The action is intermittent, with only two moving parts, both self cleaning at each discharge.

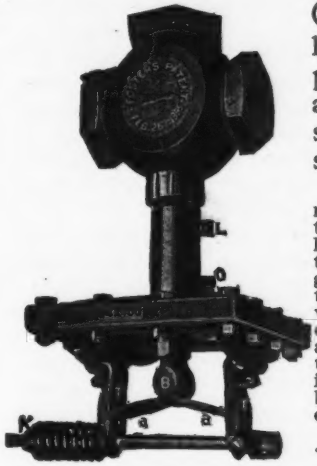
Send for Bulletin 207A for the other features of the Hydromatic

THE OHIO BLOWER CO., 5124 Perkins Ave. Cleveland, Ohio.

For Safety, Sureness of Operation and Durability

FOSTER PRESSURE REGULATORS

for STEAM HEATING SERVICE



(Classes "Q" and "Q H") lead the way. Designed especially for steam heating, and suitable for vacuum systems, for delivery pressure of from 1 to 15 lbs.

We make several types of pressure regulators—those shown in the illustrations here were designed particularly for steam heating service, and they are very sensitive, reliable, high grade in every particular and superior to other makes in construction and workmanship. there are no weights or close fitting pistons, and are easily adjusted to the desired pressure between 1 and 15 lbs. Made in sizes ¾ inch to 2 inches inclusive, composition body. Larger sizes are fitted with composition renewable seats.

Class "Q" Class "Q H"

These Valves are fully explained on Pages 29 to 33 of our General Catalogue, No. 20.

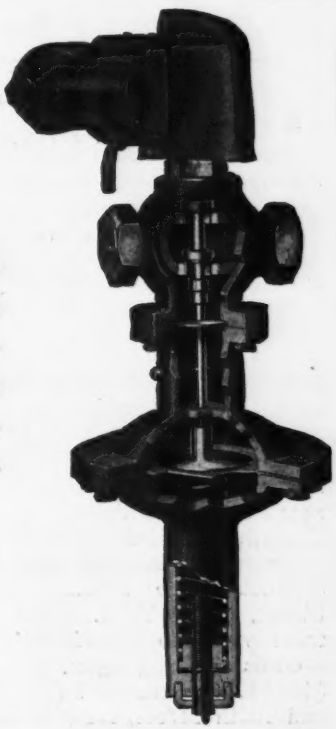
FOSTER ENGINEERING CO., Newark, N. J.

CHICAGO, ILL., 189 North Dearborn Street PHILADELPHIA, PA., 601 Harrison Building
PITTSBURGH, PA., 518 Park Building BOSTON, MASS., 161 Summer Street

ECONOMY
AND
REFINED HEAT

BOTH FROM ONE VALVE

The **HORNUNG Pressure** and **Temperature Control Valve** employing an electric thermostat of the 8-day Clock type is the Ideal Valve to control a vapor or atmospheric system of Heating where service is taken from a Central Station.



A Post Card will bring you Bulletin No. 12, which tells you more about it

Central Heat Appliances

J. C. HORNUNG

343 South Dearborn Street, Chicago

Patented June 16, 1914

Contracts Awarded.

L. H. Prentice Co., Chicago, Ill., heating, ventilating and power plant equipment for the new Public Library, in Detroit, in Detroit, Mich. The contract amounts approximately to $200,000.

Wells & Stump, Oskaloosa, Ia., were awarded the contract for the heating, plumbing and vacuum cleaning equipment for the new women's dormitory at Penn College, at their bid of $12,535 for the heating and $12,948 for the plumbing and vacuum cleaning. Other bids were: Ewinger Co., Burlington, heating $12,438; plumbing and vacuum cleaning system, $13,105; Carstens Bros., Ackley, heating $12,565; plumbing alone $12,884.

Thomas F. Butler, Lorain, O., split system of heating for the new school building in Lorain for $7,465. Other bids were: American Warming & Ventilating Co., Toledo, indirect steam complete with plumbing and mason work, $7,040; hot air, $5,590; Lane-Bowen Co., Lorain, split system complete, $10,350 (of this $7,995 was for the heating plant, $1,800 for mason work and $705 for the plumbing; Miles Heating and Ventilating Co., Cleveland, $7,660 (heating only); Columbus Heating and Ventilating Co., $7,995 (complete).

Pulte Plumbing & Heating Co., Grand Rapids, Mich., heating and plumbing the Sturgis High School building in Grand Rapids, Architects, Robinson & Campau.

Hanson Plumbing Co., Butte, Mont., heating, ventilating and plumbing the new Lake Avoca school and annex of the Emerson School for $26,750.

Enterprise Steam and Hot Water Heating Co., Baltimore, Md., heating, ventilating, vacuum cleaning and fire protection systems for the new Public School No. 101-111; also heating two large shops for the Maryland Steel Company.

Hankee Heating Co., St. Paul, Minn., heating and ventilating new St. Paul Athletic Club building at Fourth and Cedar Streets, St. Paul, for $80,000. Provision is made for cooling all the public rooms in hot weather.

Healy Plumbing & Heating Co., St. Paul, Minn., heating, ventilating and plumbing new $200,000 high school building at Eveleth, Minn., for $50,000.

James H. Merritt, New York, heating $700,000 office building at 110 William Street, New York. The plumbing contract went to Cranford Bros., Brooklyn.

Gillis & Geoghegan, New York, heating $400,000 apartment building at Broadway and 105th Street, New York.

New Firms and Business Changes.

Walter Kidde & Co., New York, is the new title of the engineering and constructing firm of Walter Kidde. The firm's quarters are at 180 Cedar Street. This business was established in 1900 and has specialized in the construction and equipment of factories. The new organization includes departments of construction, hydraulics, steam and mechanical engineering, electrical engineering and chemical engineering. The officers of the company are: President, Walter Kidde; vice-president, B. G. Worth; secretary and treasurer, I. R. Lewis; board of directors: above-named officers and Henry Lang, vice-president of the Ingersoll-Rand Co., and E. S. Boyer, of the American Hard Rubber Co. Mr. Kidde's other principal associates who compose the engineering board of the new corporation are A. B. Miller, Walter S. Wainwright, M. I. Butterfield and E. Schwartz. The chief draftsman is Thorlief Fliflet.

Patents on Crescent Heating Apparatus Upheld.

The long-pending suit of W. H. Pearce & Co., Chicago, manufacturers of the Crescent line of heating apparatus, which suit was filed against the Gordon Company and Sears, Roebuck & Company, of Chicago, has been adjudicated in the United States Federal Court in Chicago and the Pearce patents have been declared valid. It appeared from the evidence furnished by W. H. Pearce & Company that Sears, Roebuck & Company manufactured the infringements through the Robert Gordon Company, steam fitting contractors. The Gordon company furnished sketches of the apparatus to the Crane Company, which, it was testified, with full knowledge of the fact that the Pearce apparatus was patented, constructed the infringing apparatus which the Robert Gordon Company installed at the plant of Sears, Roebuck & Co., in Chicago.

The defendant's testimony endeavored to show priority of invention and prior use.

The jury awarded to W. H. Pearce & Company the full amount of their claims, together with costs.

Houghton Heating Line Sold to Bishop-Babcock-Becker Company.

E. F. Houghton & Co., Philadelphia, Pa., have sold their heating and engineering department to the Bishop-Babcock-Becker Co., Cleveland, O. The retirement of the Houghton Company from this field, it is stated, is due to the impossibility of obtaining machines and special tools and the scarcity of raw materials and labor.

The Heating and Ventilating Magazine

VOL. XIV. NO 7.

Contents for July, 1917

Schoolhouse Heating and Ventilating in Indiana 13
Analysis of Existing Conditions, Covering Warm Air Furnace, Steam and Hot Water Systems.

Radiation Requirements Under Varying Temperature Conditions
Edward B. Johnson 22
With Chart Giving Graphic Solutions for Use in Weather Above and Below Zero.

The Transmission of Steam Heat from Central Plants .....*W. H. Pearce* 25

National District Heating Association..... 29
Proceedings Ninth Annual Convention.

Air Cooling and Refrigeration 43
Refrigeration by the Absorption System.

Heating Standards Adopted by the Chicago Master Steam Fitters' Association 45

Legal Decisions 47
Competing Companies.
Suit on Contracts.
Review of Assessments by Courts.

Difference Between Initial and Normal Heating of a Radiator.....*H. S.* 47

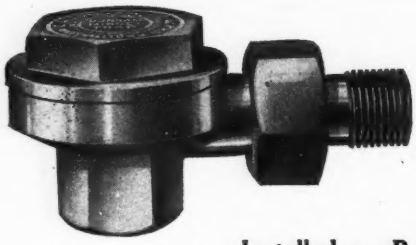
Correspondence 48
Basis for Figuring Condensation in Steam Heating System per Year.
Figuring Heater Sizes for Hot Water House Service

A Residence Without a Chimney 49

The Weather for May, 1917 52
New York, Boston, Pittsburgh, Chicago and St. Louis.

Standard Heating and Ventilating Data Sheets 57
No. 9—Properties of Air.
No. 10—Ducts and Flues.
No. 10-a—Elbows.
No. 10-b—Anemometer Readings.

YEARLY SUBSCRIPTION $1.00 **SINGLE COPIES, 10 CENTS**
Published monthly at Cooperstown, N. Y., by the Heating and Ventilating Magazine Co.
Executive and Editorial Offices, 1123 Broadway, New York



The DUNHAM Radiator Trap

Installed on Radiators in either Vacuum or Vapor Heating Systems insures highest radiator efficiency with absolutely automatic control.

The Dunham Trap is one of the fundamentals of the Dunham Heating Systems. It makes impossible the presence of water in the radiator. Positively prevents all steam waste but allows free passage of air and water of condensation. Prevents pounding and knocking in pipes. Reduces fuel consumption. Causes each individual radiator to heat evenly and quickly. Eliminates the hissing air-valve and spurting water.

Investigate. Write for Bulletin No. 5

C. A. Dunham Dompany

MARSHALLTOWN, IOWA

New York Chicago San Francisco

CANADIAN FACTORY—TORONTO

Branches in principal cities within the United States and Canada

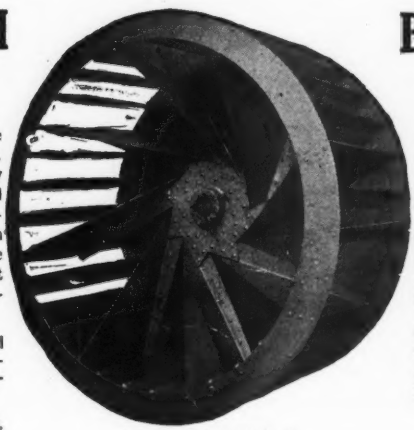
BICALKY

BI-MULTI FANS

are used all over the country and abroad. They are specified by leading engineers and architects. Their design and construction permit operating these fans at the highest pressure without racking.

The efficiency obtained with these fans has upset all previous engineering dope.

We guarantee results. Write for Catalogue.



Single Inlet Wheel

BI-MULTI FAN WHEELS

are built exceptionally strong. They are guaranteed to stand up and do not rack under the heaviest work that fans are subjected to.

This, in connection with their high efficiency, has created the large demand for

BI-MULTI FANS

BICALKY FAN COMPANY Buffalo, N. Y.

SALES AGENTS

Batterman, Truitt Co., 18-20 East Kinzie St., Chicago, Ill.
J. S. Chapman & Co., 89 Jarvis St., Toronto, Ont.
Schellhammer & Co., Warren Pa.
H. Carlton Hewitt Co., 1105 Walnut Ave., Cleveland, O.
Chas. W. Carll's Sons, 3-7 West Front St., Trenton, N. J.
The O'Keefe-Hayward Co., 1932 Dime Bank Bldg., Detroit, Mich.
Sink & Edwards, 519 Massachusetts Ave., Indianapolis, Ind.
Eagle Roofing & Art Metal Works, 203 Cass St., Tampa, Fla.